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THE

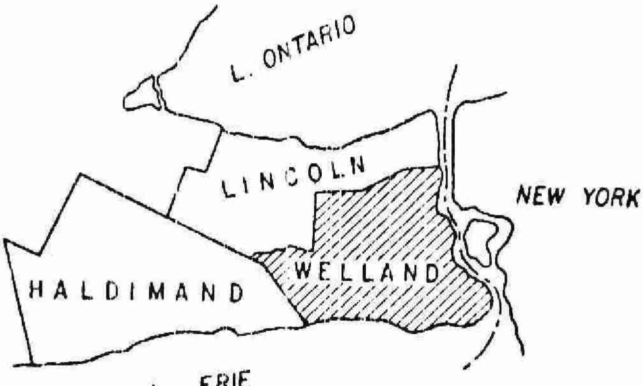
ONTARIO WATER RESOURCES

COMMISSION

WATER RESOURCES SURVEY

OF THE

COUNTY OF WELLAND



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A

Water Resources Survey

# of the

County of Welland

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INTRODUCTION

PURPOSE

The Ontario Water Resources Commission is concerned with the management of the water resources of the Province of Ontario particularly in regard to water supply and waste water disposal. In connection with this program, the Commission employs the water resources survey to study the needs of municipalities within the county unit.

The water resources survey reviews the existing water and waste water treatment facilities. The requirements of developed areas lacking adequate facilities are emphasized. The quality of the surface water is reviewed to assess the suitability for water supply and waste water disposal. Similarly, the availability and quality of ground water is examined.

Ultimately the object of the survey is to make recommendations concerning the general policies to be followed in the use of the water resources and to make more specific recommendations for each municipality.

SCOPE

The water resources survey of the County of Welland is presented in two parts. In Part I the municipal water and sewage treatment requirements as well as the stream water quality are reviewed. Industrial wastes are only included with respect to their effects on stream quality or when they interfere with sewage treatment processes. Since industrial wastes exert a considerable pollution load, and since the problems of treatment are complex, a separate industrial waste survey will constitute Part II of this report.

A general description of the county and the availability and quality of the water resources are presented in Chapters two and three.

In each of the subsequent chapters, the water supply systems and water pollution control works existing in each municipality are briefly outlined. The operational efficiency and capacity of these facilities are evaluated. Based on population projections prepared from past growth rates, the water supply and sewage treatment needs are estimated up to the year 1980. The surface water quality within each municipality is related to the major sources of pollution.

Conclusions based on the information presented in the survey are included at the end of each chapter. The summary and recommendations resulting from these conclusions constitute Chapter 1.

The maps and figures outline the areas of ground water availability, municipal water and sewage areas, stream gauging stations, sampling points on the main watercourses, and the major sources of pollution.

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ABBREVIATIONS AND SYMBOLS

ENGINEERING TERMS

BOD ✓	Biochemical Oxygen Demand
cfs ✓	cubic feet per second
gal. ✓	gallon (Imperial used throughout except where noted)
gpcpd ✓	gallons per capita per day
gpd ✓	gallons per day
gpm ✓	gallons per minute
HP	Horsepower
M.F. ✓	Membrane Filter
mgd ✓	million gallons per day
ml	millilitre
No. ✓	number
ppb ✓	parts per billion
ppm ✓	parts per million

PROPER NAMES

CN	Canadian National
HEPC	Hydro Electric Power Commission
NYCR	New York Central Railway
OWRC	Ontario Water Resources Commission
TH & BR	Toronto Hamilton and Buffalo Railway

MISCELLANEOUS

Cr.	Creek
Co.	Company
Conc.	Concession
Cont'd	Continued
Inc.	Incorporated
Ltd.	Limited
Mfg.	Manufacturing
No.	Number
Rd.	Road
STP	Sewage Treatment Plant
St.	Street
Twp.	Township
WW	Water Works
WPCP	Water Pollution Control Plant

SYMBOLS

⊗	———	Cross Connection
○	———	Elevated Tank or Standpipe
‡	———	Infiltration Well
—·—	———	Municipal Boundary
□	———	Other Establishment
⟶	———	Outfall
N 31·5 D	———	Outfall Sampling Point Type D - Ditch I - Industrial S - Sanitary W - Storm T - Treated
⊠	———	Refuse Disposal Site
↓	———	Sewage Pumping Station
△	———	Sewage Treatment Plant (WPCP)
▧	———	Sewer Area
TW 9·8	———	Stream Sampling Point
▩	———	Water and Sewer Area
▨	———	Water Area
⚲	———	Water Works
●	———	Well

CHAPTER 1

SUMMARY AND RECOMMENDATIONS

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CHAPTER I

SUMMARY AND RECOMMENDATIONS

I SUMMARY

The County of Welland consists of 15 municipalities including two cities, three towns, three villages and seven townships. The backbone of the economy consists of extensive and diversified manufacturing and processing industries, including pulp and paper mills, metal refining, and chemical plants. A tourist industry is focused at Niagara Falls and extends along the Niagara River and the Lake Erie beach. Both urban and industrial development are progressing rapidly.

The county is favourably located with respect to plentiful surface water resources of suitable quantity and quality for potable and industrial water supplies. The Welland Ship Canal, transporting Lake Erie water, bisects the county, and is used as a major source of water supply. Other major sources of surface water supply include Lake Erie itself and the Niagara River. As the urban areas grow the various separate water works systems could gradually be integrated into a water supply network which will ensure full development of the county.

Throughout most of the county, plentiful ground water supplies from the overburden are scarce and wells drilled into the bedrock generally produce mineralized water, unsatisfactory for drinking purposes. In the Township of Pelham, good quality water is available from overburden aquifers in some areas in sufficient quantities to meet the domestic needs of small residential communities. Suitable supplies also can be derived from scattered overburden and bedrock aquifers in the Township of Thorold and in the northern portion of the Township of Wainfleet in sufficient amounts for private domestic needs. Small quantities of ground water have been developed as private supplies a short distance from the Lake Erie shore.

There are nine municipal water works installations in the county serving the cities of Niagara Falls and Welland, the towns of Fort Erie, Port Colborne, and Thorold, the villages of Crystal Beach and Fonthill, and portions of the townships of Bertie and Thorold. With the exception of the Village of Fonthill all supplies are obtained from surface waters. The OWRC operates the Township of Bertie system. In most cases the quality of the water supplied is satisfactory. However, several of the supplies require improved treatment. To meet the needs of expanding populations extensions to the present facilities are required.

A private water supply from Black Creek serves a small area of the Township of Willoughby. Numerous private water supplies serve the summer cottage areas along the Lake Erie shore. In most cases the private communal supplies are derived from surface waters.

Large quantities of water, exceeding the municipal pumpage, are drawn by industry from Lake Erie, the Niagara River, the Welland River and the Welland Ship Canal, through private water works systems. Limited use is made of ground water for industrial supplies.

Considering the importance of surface waters in the county for water supply purposes it is necessary that domestic and trade wastes receive adequate treatment. The City of Niagara Falls, the towns of Fort Erie and Port Colborne, and the villages of Chippawa and Crystal Beach have sewage works serving either portions or the whole of the municipality. The City of Welland discharges raw domestic sewage and trade wastes to the Welland River causing considerable pollution. The Town of Thorold has a system of sanitary sewers which is being connected to a new trunk sewer which connects to the City of St. Catharines sewerage system. The Village of Fonthill is served entirely by private septic tank systems. The Town of Port Colborne is gradually completing the sewering of the municipality. The Ontario Water Resources Commission has co-operated with the towns of Fort Erie, Port Colborne and Thorold in the construction of sewerage facilities and presently operates two water pollution control plants in the Town of Port Colborne, and one in the Town of Fort Erie. The unorganized communities of Stevensville and Ridgeway represent sizeable population concentrations which are served by private disposal systems resulting in considerable pollution of local ditches and streams. Residential areas along the Lake Erie shore including Crescent Beach, Waverly Beach and Erie Beach, similarly cause pollution of Lake Erie beaches and tributary streams.

With the exception of the townships of Bertie and Pelham, the Town of Fort Erie, and the villages of Chippawa and Crystal Beach, the Welland and District Health Unit actively supervises the installation of private disposal systems in the rural and suburban areas.

Industrial waste discharges to Twelve Mile Creek via the Second Welland Canal industrial waste drain constitute the most significant source of pollution in the county. Considerable quantities of industrial wastes are also discharged to the Welland River from industries connected to the City of Welland sewers. Because of the complexity of these wastes, Part II of this report (to be published at a later date), will deal with these problems in detail.

The water quality of the Niagara River and Lake Erie is generally satisfactory although both contain relatively large quantities of organic material. The Welland River and its tributaries are highly polluted downstream from the City of Welland. The Welland Ship Canal has been fairly well protected from the discharges of contaminating materials and is a satisfactory water supply source along its full length throughout the county. Pollution problems have at times been observed resulting from the discharge of domestic wastes and oil from shipping.

The DeCew Falls tributary of Twelve Mile Creek has a satisfactory quality. However, the main stream in Lincoln County receives a large pollution load from the Second Welland Canal industrial waste drain. Black Creek is polluted downstream from Stevensville. The various other small creeks in the county have indicated excessive coliform counts downstream from minor sources of pollution. Although considerable work on pollution abatement programs has been carried out, the adverse quality of the Welland River, Black Creek, Second Welland Canal, Lyon's Creek, Six Mile Creek and other small watercourses, demonstrates the need for continuing these programs and providing suitable treatment facilities.

Growths of the algae Cladophora and other algal species become excessive during the summer months along the Lake Erie shore. The decaying vegetation is deposited on the shore causing malodorous and unsightly conditions on the beaches. Interference with water treatment also has been experienced. Experiments with various algicides have been carried out by the OWRC Biology Branch to control the growths. Research is continuing.

II RECOMMENDATIONS

General Recommendations

1. The use of the small watercourses such as Black Creek and Frenchman Creek for water supply and sewage disposal purposes should be discouraged.

2. Pollution abatement programs for municipal and industrial wastes should be continued.

3. The discharge of polluting waste water to the Welland Ship Canal should be curtailed to protect its use as a water supply source.

City of Niagara Falls

Water Supply

1. Additional filtration capacity should be provided as required by the expanding population.

2. Distribution storage facilities should be provided to meet fire requirements, and peak demands.

3. Replacement of small diameter mains should continue as required by engineering studies undertaken to improve pressures and fire protection.

Water Pollution

1. The sewered areas presently served by the McLeod Road and Stanley Street settling tanks should be connected to the sewage treatment plant.

2. A comprehensive sewer use or industrial waste by-law should be enacted and enforced.

City of Welland

Water Supply

1. Increased filtration capacity should be provided to meet future requirements.

2. Elevated storage should be provided in the southern portion of the city.

Water Pollution

1. A treatment plant capable of providing secondary sewage treatment should be provided.

2. Diversion of at least 250 cfs dilution water to the Welland River should be continued.

3. Improved storm sewers should be installed and where feasible storm water separated from the domestic and industrial wastes.

4. A comprehensive industrial waste by-law should be enacted and enforced to protect the present sewerage system and the intended secondary treatment facilities.

Town of Fort Erie

Water Supply

1. Improved water treatment, including pre-chlorination, coagulation, settling, rapid sand filtration and post-chlorination facilities should be provided.

2. Improvements in the distribution system such as replacement of small diameter mains and elimination of dead ends should be undertaken.

Water Pollution

1. All buildings within the sewered areas should be connected to the municipal sewerage system.

2. Improved refuse disposal practices should be carried out to stop pollution of the ditch tributary to Frenchman Creek.

Town of Port Colborne

Water Supply

1. Improved and enlarged water treatment facilities are required including, pre-chlorination, coagulation and settling, rapid sand filtration and post-chlorination.

2. Additional elevated storage should be located on the east side of the Welland Ship Canal.

3. Replacement of undersized mains is required.

Water Pollution

1. The sewering of all developed areas in the municipality should be completed.

2. The south-west sewage treatment plant should be constructed to serve development in this area of the town.

3. The east side plant requires extension to treat the total flow.

4. Renovations which should be carried out at the east side plant include:

    (a) provision of primary treatment and effluent chlorination facilities.
    (b) repair of the aerators.

Town of Thorold

Water Supply

1. Increased filtration capacity will be required to meet increasing water demands.

Water Pollution

1. A reduction in the strength of industrial wastes discharged to the Second Welland Canal is necessary.

2. Connection of all main sanitary sewers to the new trunk sewer should be implemented.

3. An industrial waste by-law should be enacted to protect the sanitary sewer system.

Village of Chippawa

Water Supply

1. Improvements in the distribution network are required.

Water Pollution

1. All roof drain connections to the sanitary sewers should be located and severed.

Village of Crystal Beach

Water Supply

1. Expansion of the filtration capacity will be required to meet future demands.

2. Consideration should be given to the installation of coagulation and settling facilities.

Water Pollution

1. Improved sewage treatment works are required, capable of treating the high summer loading as well as the normal flows.

Village of Fonthill

Water Supply

1. A ground water survey followed by a test-drilling program should be carried out to locate additional supplies.

2. Increased storage should be provided to meet fire requirements.

Water Pollution

1. A system of sanitary sewers and sewage treatment facilities capable of providing secondary treatment should be installed.

Township of Bertie

Water Supply

1. An additional micro-strainer should be installed increasing the capacity of the water works to 9.0 mgd.

2. Consideration should be given to the provision of complete water treatment including, coagulation, settling and rapid sand filtration facilities.

Water Pollution

1. The communities of Ridgeway, Stevensville, Erie Beach, Waverly Beach and Crescent Park should provide

sanitary sewers and sewage treatment.

2. Consulting engineers' reports should be prepared to determine the requirements for suitable facilities.

3. The municipal refuse disposal site should be operated in a fashion to prevent the contamination of the local watercourse.

Township of Crowland

Water Supply

1. The Ford Motor Company Limited, should improve its drinking water quality by storage prior to treatment, or by locating an alternate source of supply.

Water Pollution

1. More efficient treatment of the sanitary wastes from the Ford Motor Company Limited should be provided.

Township of Humberstone

Water Supply

1. Larger capacity water supply feeder mains should be provided to serve Welland Junction and the surrounding development.

Water Pollution

1. A sanitary sewerage system is required for the Welland Junction area.

Township of Pelham

Water Supply

1. Further consideration should be given to the development of municipal water works systems to serve the Police Village of Fenwick, Pelham Centre, and Ridgeville.

Water Pollution

1. Improved waste water treatment is required at the Welland-Crowland Airport, the P. Krusell poultry killing establishment, and the Tregunno Niagara Farms Limited.

Township of Thorold

Water Supply

1. A municipal water supply system should be developed at Port Robinson.

2. Improved settling and coagulation facilities, and increased filtration capacity should be provided at the Thorold South water works.

Water Pollution

1. Treatment of the industrial wastes prior to discharge to the Second Welland Canal industrial waste drain and Beaver Dams Creek is required.

2. Connection of the Thorold South sewers to the Town of Thorold trunk sewer should be expedited.

3. The Thorold South sewers should be extended to serve Windle Village and the Beaverwood homes.

4. Improved refuse disposal is required to eliminate the possibility of pollution of the upper reaches of Twelve Mile Creek.

Township of Wainfleet

Water Supply

1. Consideration should be given to the provision of municipal water and sewerage works in densely populated areas along Lake Erie.

2. Improved chlorination should be practised at the Wayne Park water works system.

Township of Willoughby

Water Supply

1. An improved water supply should be provided for the Community of Douglastown.

Water Pollution

1. The private disposal systems in Douglastown should be improved and maintained in good operating condition.

CHAPTER 2

GEOGRAPHY AND GEOLOGY

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CHAPTER 2

GEOGRAPHY AND GEOLOGY

I GEOGRAPHY

1. Location

The County of Welland is situated in the Niagara Peninsula in the southern part of the Province of Ontario. It is bounded by the County of Lincoln on the north, the County of Haldimand on the west, Lake Erie on the south, and the Niagara River on the east. The Niagara River forms the international boundary line between Canada and the United States and flows in a northerly direction from Lake Erie to Lake Ontario.

2. Topography and Drainage

(a) Topography

The county has a total land area of 387 square miles, an average length of 24 miles in the east-west direction and an average width of 16 miles in the north-south direction.

The land surface is predominantly a clay plain bounded by Lake Erie on the south, the Niagara Escarpment on the north, and the Niagara River on the east. The nearly level plain is at an elevation of approximately 600 feet above sea level and is broken by rolling hills and deep valleys in the Township of Pelham where elevations vary from 350 to 850 feet. The Niagara Falls and the deep gorge of the Niagara River are the most notable features of the topography of the county.

(b) Drainage

Drainage is generally towards the Niagara River and Lake Ontario, but a narrow strip of land on the southern edge of the county drains to Lake Erie. Most of the surface area is drained by the Niagara River, the Welland River, Twelve Mile Creek, and the various tributaries. Four artificial canals are also a feature of the drainage pattern. The Welland Ship Canal bisects the county in a north-south direction joining Lake Erie and Lake Ontario. The disused Feeder Canal crosses the south-west corner from Dunnville to the Welland River. The Chippawa-Queenston Power Canal connects with the Welland River and the Niagara River. The Second Welland Canal, which was formerly the ship canal route, has been partially covered and now is utilized as an industrial waste drain passing through the Town of Thorold to Twelve Mile Creek.

The Welland River which generally flows in a west to east direction drains approximately 40 per cent of the surface area. Originally this river discharged into the Niagara River at Chippawa. However, when the HEPC constructed the Chippawa-Queenston Power Canal the flow in the last four-mile reach was reversed and Niagara River water now flows up the Welland River into the canal. The backwater effects created by the operation of the power canal affect the flow upstream from the City of Welland. The average slope of the stream bed approximates one foot per mile creating a very sluggish flow.

To the north, the Welland River watershed is bounded by the basins of Twelve Mile Creek, Fifteen Mile Creek and Sixteen Mile Creek which discharge into Lake Ontario.

Ten Mile Creek, Shriners Creek and Beaver Dams Creek in the north-eastern portion of the county have been diverted from Twelve Mile Creek and now flow to the Welland Ship Canal. A stub end of Beaver Dams Creek is siphoned under the canal and pumped into Gibson Lake. Similarly, a short section of Shriners Creek is siphoned under the canal and discharges to the Second Welland Canal industrial waste drain.

The Welland Ship Canal provides little drainage for the county. Most large streams are carried under the canal in artificial conduits so that their drainage is not affected. For example, the flow in the Welland River is carried under the canal at the City of Welland in an inverted siphon with six tubes each 22 feet in diameter. Water is diverted from the canal at Allanburg to the Twelve Mile Creek system to generate power at DeCew Falls and to provide water for the City of St. Catharines in the County of Lincoln.

The south-eastern portion of the county drains to the Niagara River via Usshers Creek, Bayers Creek, Black Creek, Miller Creek and Frenchman Creek.

Although drainage in the northern sections of this county is generally adequate, natural drainage in the southern portions has proven to be inadequate. Large bog areas exist in the townships of Wainfleet, Humberstone and Willoughby. Many miles of drainage ditches have been excavated to facilitate runoff and agriculture.

The drainage pattern is illustrated in Figure 2-1.

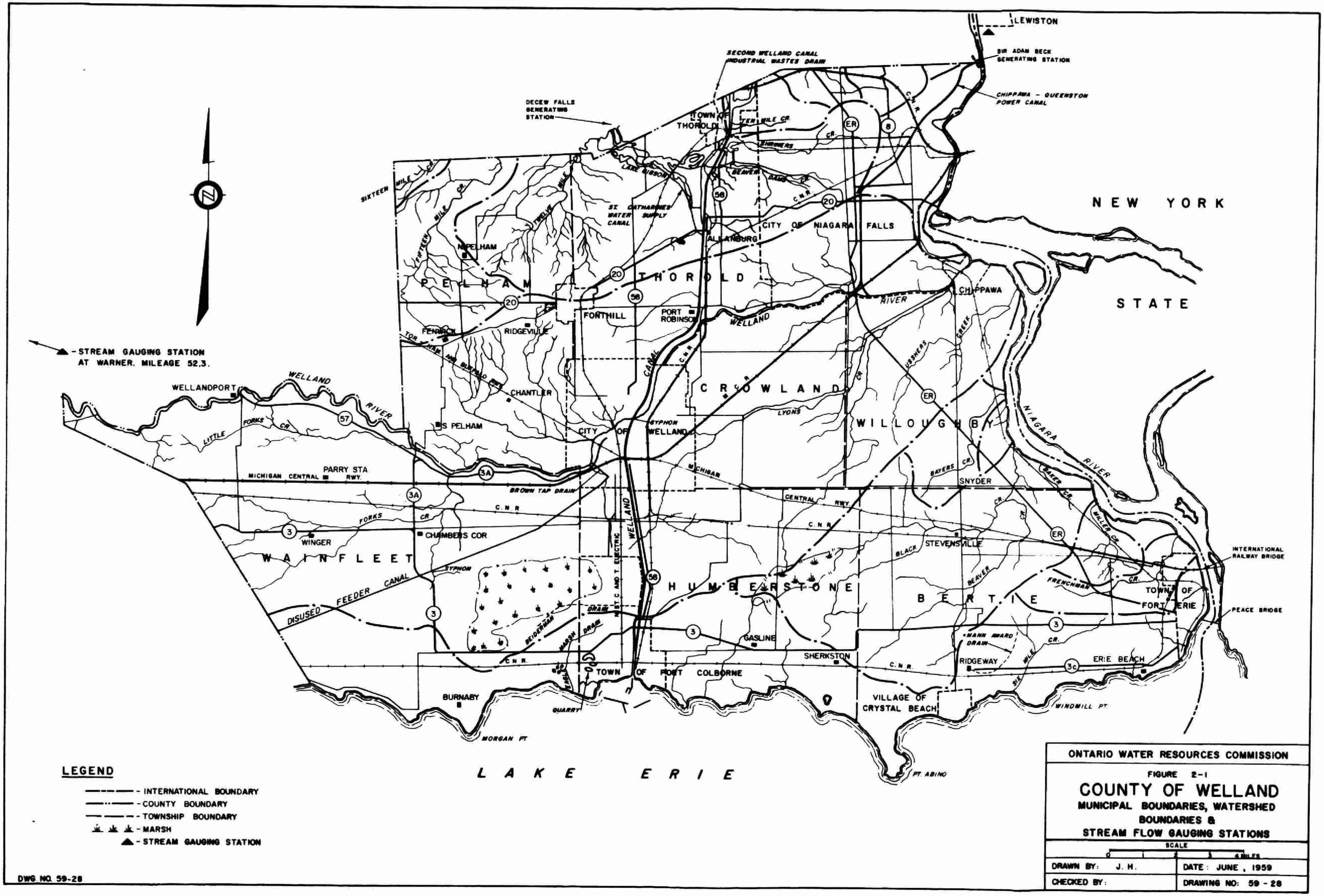

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FIGURE 2-1

COUNTY OF WELLAND

MUNICIPAL BOUNDARIES, WATERSHED BOUNDARIES & STREAM FLOW GAUGING STATIONS

DRAWN BY: J. H.	DATE: JUNE, 1959
CHECKED BY:	DRAWING NO: 59 - 28

3. Climate

The climate is relatively warm in comparison with most parts of Canada. This is due partly to the southern latitude and partly to the modifying influence of the Great Lakes. The average daily maximum temperature is 56°F and the average daily minimum is 38°F. Similarly, the average daily mean temperature at the City of Welland over a 45-year period has been 47.0°F.

The average annual precipitation at Welland is 40.6 inches. Records indicate that the rainfall in the county varies from 0.5 to 4.8 inches per month, and that periods of heavy rainfall are frequent. The seasonal variation in precipitation is not excessive.

The county is subjected to storms which sweep in from Lake Erie.

4. Population

180, 650 (1968)

The total population of the county is 167,455 of which 80 per cent is concentrated in the cities, towns and villages. The major concentrations include Niagara Falls in the north-east corner and the urban areas situated along the Welland Ship Canal, i.e. Port Colborne, Welland and Thorold. To accommodate increasing populations the boundaries of these municipalities are expanding and growing towards one another. Development also occurs along the Niagara River south from Niagara Falls to Fort Erie. Along the whole Lake Erie shore a narrow strip of land is fairly heavily populated. The population of this area increases greatly during the summer months because of the large number of summer cottages. The rural and suburban municipalities have populations less that 9,000 persons.

Population growth has proceeded at an average rate of approximately two per cent per year over the past ten years. In Figures 2-2A and B the populations are projected at rates corresponding to those experienced since 1940. In many cases the projections are adjusted to account for the industrial growth etc. Projections prepared by planning boards, consulting engineers and the Special Studies Branch of the Department of Municipal Affairs were studied. The estimated populations are used for assessment of future water supply and sewage disposal requirements. By 1980, the total population of the county is estimated at 250,000 persons.

FIGURE 2 - 2A

COUNTY OF WELLAND

POPULATION STUDIES, URBAN MUNICIPALITIES

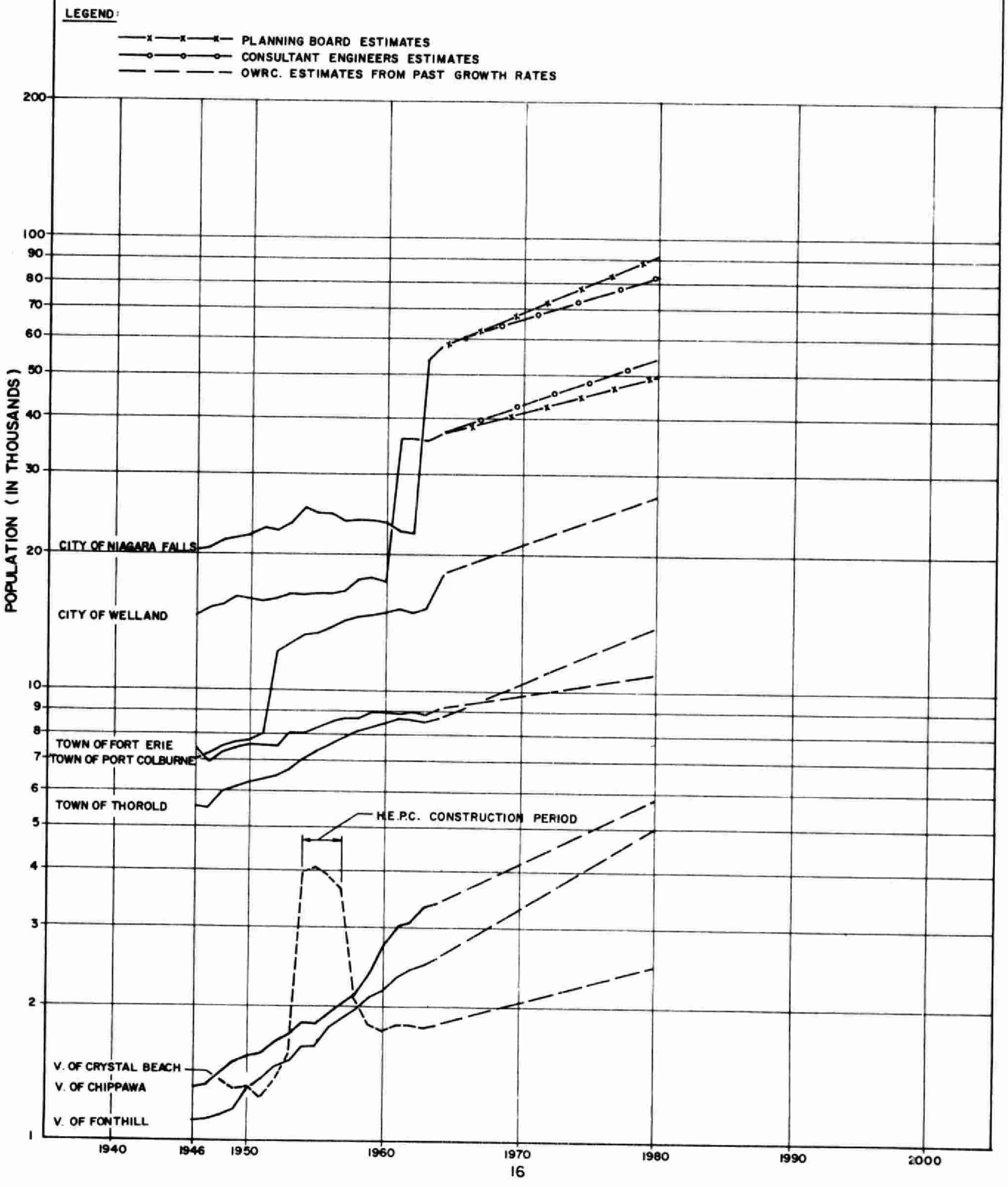
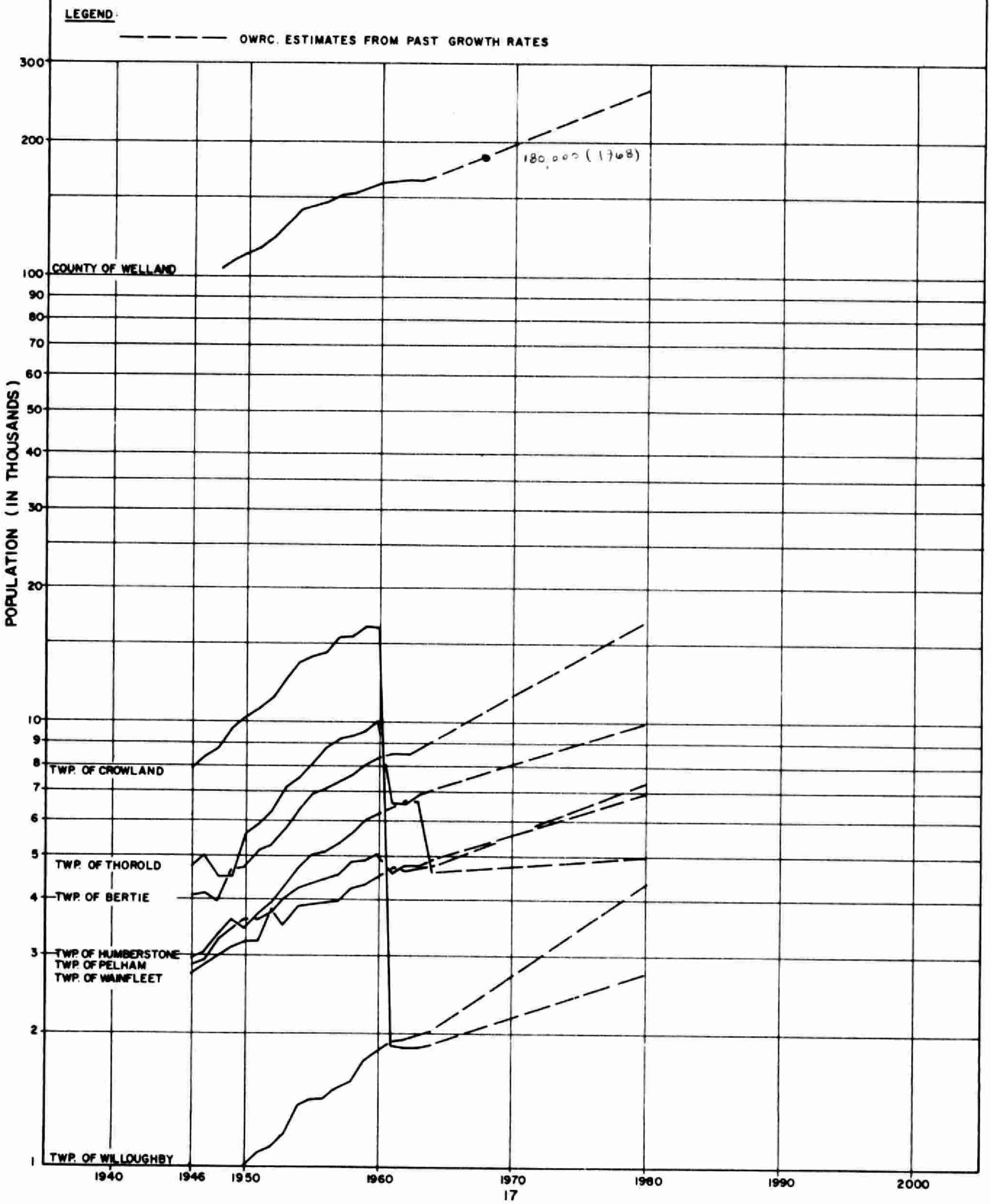


FIGURE 2-2B

COUNTY OF WELLAND

POPULATION STUDIES, COUNTY AND RURAL MUNICIPALITIES



5. Industry

The County of Welland is favourably located for the development of industry. Relatively inexpensive electric power and natural gas are available, as well as suitable water supplies. Transportation including rail, road and shipping facilities are well developed. In addition, the major markets of southern Ontario are within a radius of 150 miles. As a result, industrial development has been extensive. Plants producing and processing steel, chemicals, pulp and paper, textiles, abrasives, food, etc. are located in the county. The major industrial centres are the cities of Welland and Niagara Falls and the towns of Thorold, Port Colborne and Fort Erie. A number of large industries are also located in the townships adjacent to these centres.

6. Agriculture

The main types of agriculture are fruit farming and market gardening. Mixed farming is carried out to some extent in most areas. Such crops as wheat, corn, grapes, and beans are well adapted to the fine-grained soil of the clay plain which makes up the greater part of the county, although the flat topography and the character of the soil have resulted in poor drainage in many parts of the plain. Fruits and vegetables are commonly grown in the Pelham and Niagara Falls areas where the soil is lighter. Some irrigation is practised.

II GEOLOGY

The geologic formations in the county consist of consolidated bedrock of Silurian and Devonian age and unconsolidated overburden deposits that are mainly of Pleistocene age.

1. Bedrock

The Niagara Escarpment which forms a prominent topographic feature along the north boundary is made up of bedrock formations of dolomites, limestones, sandstones and shales of Silurian age. These outcrop at the face of the escarpment and underlie the mantle of overburden in most parts as a series of east-west bands. Progressively southward from the escarpment these formations are the Lockport, Guelph, Salina, and Bass Island. Grey, cherty limestones and dolomites of the Bois Blanc formation are of Devonian age and outcrop and underlie the overburden in the south. This formation occurs as a narrow band parallel to the Lake Erie shore. The succession of Silurian formations underlies the Devonian rocks. All the formations dip gently towards the south and under Lake Erie.

The topography on the bedrock surface is quite variable. Highs on the surface occur along the Lake Erie shore and along the Niagara Escarpment. Depressions in the bedrock surface tend to parallel the Welland River. The deepest depression occurs under the Township of Wainfleet.

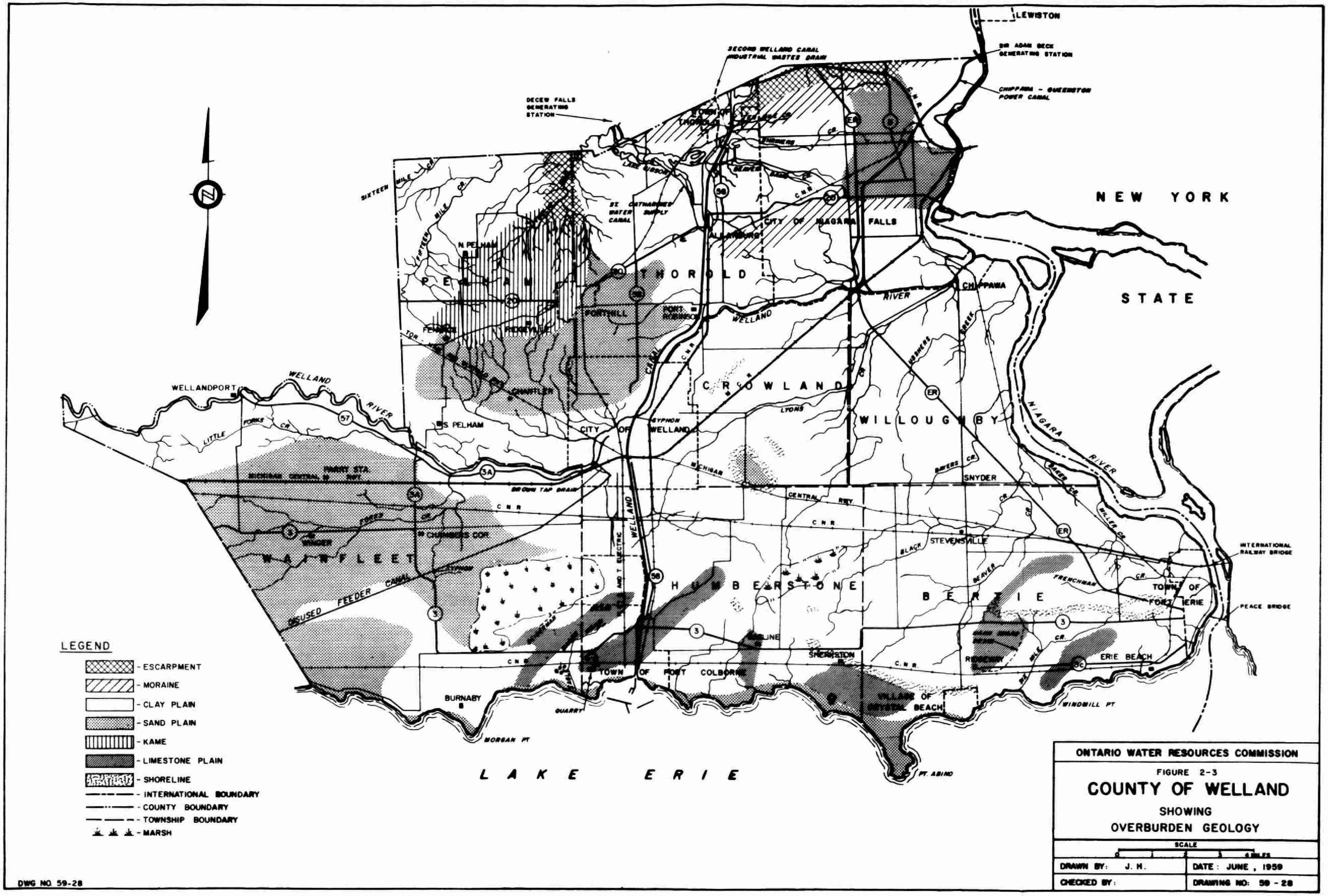
2. Overburden

The overburden is the result of deposition during the glaciation and deglaciation of the area in Pleistocene times. The principle types of surficial geologic features include sand and clay plains, glacio-fluvial deposits or kames, and till moraines. More recent deposits are sand dunes and beaches along the shore of Lake Erie and the large tracts of marsh in the townships of Wainfleet and Humberstone.

The overburden in most parts is generally less than 100 feet in thickness and is almost non-existent in large parts of the townships of Humberstone and Bertie. Only in the townships of Wainfleet and Pelham does it attain greater depths. Thicknesses of up to 365 feet are reported in the eastern sections of the Township of Pelham.

As the last ice sheet advanced through the area from the Lake Ontario basin, it deposited unconsolidated material which was derived from the bedrock and previous overburden deposits in the areas over which the ice had advanced. Materials deposited by ice are called till and consist of poorly-sorted mixtures of clay, silt, sand, gravel, and sometimes boulders. This material is believed to underlie most of the county and to comprise a large portion of the overburden.

During deglaciation, the ice front retreated gradually to the north but made at least two halts or short readvances. During these halts or readvances till was built up in front of the ice in the form of ridges or moraines. One of these moraines extends westward from Niagara Falls and another occurs along the edge of the escarpment. During the retreat a large outlet for meltwater developed in the ice front in Pelham and glacio-fluvial deposits or kames of sand and gravel were built up in the area by the discharging of meltwater at the mouth of the outlet. The meltwater gradually formed lakes in front of the ice and built a delta. The materials deposited in the delta consist of well-sorted sand and silt and sometimes sand and gravel. This material covers the southern part of Pelham and much of Wainfleet. Other materials were deposited in the glacial lakes around the delta and these consist mainly of clay. In the broad flat areas of the county the overburden is composed mainly of clay and till. Figure 2-3 shows the main overburden materials and areas of outcrop in the county.



ONTARIO WATER RESOURCES COMMISSION

FIGURE 2-3

COUNTY OF WELLAND

SHOWING

OVERBURDEN GEOLOGY

DRAWN BY: J. H.	DATE: JUNE, 1959
CHECKED BY:	DRAWING NO: 59 - 28

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CHAPTER 3

WATER RESOURCES

I GROUND WATER

1. Occurrence

Ground water is water that occurs in the zone of saturation below the surface of the ground. In this zone all openings in the earth's formations are filled with water which is replenished by precipitation infiltrating from the land surface. The upper surface of this zone is called the water table and fluctuates annually in relation to the amount of precipitation that enters the ground. Ground water is constantly moving in the zone of saturation but the rate of movement depends on the permeability of the earth's formations. Formations that permit appreciable quantities of water to move through them are called aquifers.

In the county, ground water occurs in aquifers in three types of formations; the deltaic surface sand and gravel, the sand and gravel deeper in the overburden, and the limestone and dolomite bedrock. The surface aquifer covers the southern part of the Township of Pelham and the western part of the Township of Wainfleet, and constitutes an important source of water for shallow wells in these areas. The deeper sand and gravel deposits in the overburden are very patchy in distribution throughout the county. In Pelham where the overburden is generally thicker, sand and gravel lenses are more common and often yield adequate quantities of water for domestic and small municipal needs. The water-bearing properties of the bedrock are variable. Aquifers in the bed-rock are the main source of water for drilled wells in many parts, especially in areas where the overburden is thin and overburden aquifers are lacking. Although adequate quantities of water for domestic needs are usually obtained from the upper parts of the bedrock, the water in numerous wells is reported to be highly mineralized.

2. Availability

The amount of ground water available to wells depends on the permeability of the water-bearing formations. Ground-water conditions can be described in general terms as being fair to good in a few sections of the county and poor to fair in the others.

Overburden formations of sand and gravel are generally the most permeable and as these deposits are common in the townships of Pelham and Wainfleet they constitute important aquifers for the development of large water supplies. The surface sand formations in these areas are less permeable but can constitute good sources of water for small supplies.

Because the overburden is very thin over much of the county, bedrock aquifers are relied upon extensively for domestic supplies. The bedrock formations yield varying quantities of water due to irregular regional permeabilities of the formations, but the supplies are usually sufficient only for domestic purposes.

3. Water Quality

Ground water from overburden sources is generally hard but suitable for most purposes. Water from rock wells is also hard and commonly contains hydrogen sulphide or other compounds which are present in such quantities in some parts of the county that the water is not potable.

II SURFACE WATER

1. Navigation

As part of the St. Lawrence Seaway the Welland Ship Canal forms a direct link between Lake Ontario and Lake Erie. The canal is the latest in a series of four ship canals constructed in the Niagara Peninsula.

It was completed in 1932 with terminals at Port Weller on Lake Ontario and at Port Colborne on Lake Erie. It has a length of 27.6 miles and its eight locks provide a total lift of 327 feet. The flow through the canal is controlled by an intake weir at Port Colborne. Plans are presently under way to twin the balance of the locks. The navigational works are an important factor in water supply and waste water disposal.

2. Hydro Electric Power Development

The concentration of power generating stations in the County of Welland has been an important factor in its development. The location of the various hydro electric developments are shown in Figures 4-1 and 16-1. The horsepower capacities of the hydro electric stations are shown on the following page.

Installation	Horsepower	
DeCew Falls (2 plants)	208,000	Figure 16-1
Sir Adam Beck Nos. 1 & 2	2,240,000)	
Pump Generating Station	282,000)	
Ontario Power)	)	Figure 4-1
Canadian Niagara)----	477,000)	
Toronto Power)		

The water supply for the Sir Adam Beck stations is obtained from both the Niagara and Welland Rivers through the Chippawa-Queenston Power Canal which carries a maximum flow of 16,000 cfs, and through two tunnels with a total capacity of 44,000 cfs. The tunnels follow a northerly direction from the intake point near Chippawa, pass under Niagara Falls, and discharge into a downstream power canal which leads to the forebays of the generating plants. This canal joins and crosses the Chippawa-Queenston Power Canal immediately upstream from the generating stations. A second connection between the two canals is effected by means of a channel connecting the forebays. A pump storage plant with a reservoir having an effective capacity of 16,000 acre-feet is connected to this system.

The hydro electric stations near Niagara Falls obtain water directly from the Niagara River. The intake works for the Ontario Power Plant are situated at Dufferin Island. The intakes for the Toronto Power and Canadian Niagara Power plants are situated downstream from Dufferin Island. The Toronto Power Generating Station is now used only as a transformer station while HEPC is planning and negotiating to utilize the water operating the other two at the Sir Adam Beck plants.

Water for the power plants at DeCew Falls is diverted from the Welland Ship Canal to the forebay, Lake Gibson, at a point near Allanburg. Outflow from Lake Gibson to Twelve Mile Creek is regulated at the power plants.

3. Water Supply

There are nine municipal water works systems in the county. With the exception of the Village of Fonthill all of these draw water from surface sources. The City of Welland, towns of Port Colborne and Thorold and the Township of Thorold withdraw approximately 14.5 mgd from the Welland Ship Canal. The City of Niagara Falls and the Town of Fort Erie utilize an average of 9.8 mgd from the Niagara River. The remainder of the 25.9 mgd municipal pumpage derived from surface waters is drawn from Lake Erie by the Village of Crystal Beach and the Township of Bertie.

Of the 23 industrial water supplies, 12 pump from the Welland Ship Canal, four draw from Lake Erie, two use the Welland River, two draw Niagara River water from the Welland River, one pumps from the Chippawa-Queenston Power Canal, and three use drilled wells. Approximately 119 mgd are obtained from these various sources. It has been estimated that 8.3 mgd of the municipal water pumpage is used for industrial purposes. The industrial water usage is approximately 88 per cent of the water pumped.

A private water supply is obtained from Black Creek to serve the Community of Douglastown. Numerous water supply systems drawing directly from Lake Erie or utilizing infiltration wells serve the summer cottage areas along the Lake Erie Beach. Many of the residences along the Niagara River draw water from this source. The rural areas utilize dug wells, drilled wells and rainwater cisterns.

Both the Niagara River and Lake Erie are sources of good quality water which will allow the full development of the county. However, the Welland Ship Canal which transports Lake Erie water through the middle of the county is the most important water supply source. Approximately 60 per cent of the total water used in the county for industrial and municipal purposes is derived from the Welland Ship Canal. In addition water is obtained from the canal to serve the City of St. Catharines and industrial users downstream in the County of Lincoln. Diversion of water from the canal for water supply and other uses is regulated by the St. Lawrence Seaway Authority. The water is leased according to the agreements noted in Table 3-1. Increase in the allowable diversions for water supply purposes could be negotiated by the individual municipality or industry. However, indiscriminate withdrawal is prevented by an esculating leasing scale. The withdrawals are maintained at a minimum for the water may be more beneficially used for power generation purposes. Also, increased diversions create greater velocities which affect navigation.

TABLE 3-1

WELLAND SHIP CANAL-ALLOWABLE WATER DIVERSIONS

WATER SUPPLY-WELLAND COUNTY

Supply	Water Drawn cfs	Water Returned cfs	Remarks
Atlas Steel Ltd.	20		
Beaver Wood Fibre Co.	13.337		
The John Deere Mfg. Co.	0.268		
John Deere Plow Co. Ltd.	2.68		
Hayes Steel Prod. Ltd.	0.14		
Ont. Paper Co. Ltd.	50.0		ind. purposes
	15.0		fire supply
Page Hershey Tubes Ltd.	7.5		
Town of Port Colborne	6.165		
Robin Hood Flour Mills Ltd.	0.5		
Town of Thorold	25.0		
Township of Thorold	0.536		domestic cons.
	1.34		fire supply
	2.0		
City of Welland	10.0		
Exolon Co.	2.25		
Union Carbide Co.	17.4	16.5	ind. purposes
	16.8	15.9	emergency purpose
HEPC	6430		DeCew Falls power generation
City of Welland	250		operation of water turbine pumps
City of St. Catharines	34		
Alliance Paper Mills Ltd.	30		
Interlake Tissue Mills	7.0		
McKinnon Industries	7.444	7.444	

4. Waste Water Disposal

The Niagara River, Welland River, Lake Erie, Twelve Mile Creek, the Welland Ship Canal, and Black Creek receive waste water effluents from municipal and industrial sources.

The Niagara River has tremendous capabilities for self purification. Primary treatment plant effluent and industrial wastes are discharged at Fort Erie. Waste flows discharged to the Welland River reach the Niagara River through the Chippawa-Queenston Power Canal.

Untreated domestic and industrial wastes discharge to the Welland River and Lyons Creek from the City of Welland. Contaminating wastes from the Cyanamid of Canada Limited, Welland works degrade Thompson's Creek and the Welland River. A small sewage treatment plant serving the Ford Motor Company Limited, Glass Fabricating Operation discharges to the Welland River west of the power canal. From the City of Niagara Falls, domestic and industrial wastes which have received sedimentation are discharged to the river east of the power canal. The effluent from a secondary treatment plant serving the Village of Chippawa also discharges into this easterly reach.

The Chippawa-Queenston Power Canal receives waste water from the McLeod Road settling tank serving a portion of Niagara Falls, the effluent from the Niagara Falls primary treatment plant, wastes from Cyanamid of Canada Limited (Niagara Falls works), and Chateau Gai Wines Limited.

Lake Erie receives the effluent from the Crystal Beach sewage treatment plant and various polluted drainage ditches in the townships of Bertie, Humberstone and Wainfleet, and the Town of Port Colborne. Industrial wastes are also discharged from International Nickel Company Limited, Algoma Steel Limited, Canadian Furnace Division, Maple Leaf Milling Company Limited, National Harbours Board, and Canada Cement Company Limited in Port Colborne and from Wallace and Tiernan Limited in Bertie.

The Second Welland Canal, industrial wastes drain, which is tributary to Twelve Mile Creek, represents the greatest concentration of pollution within the county. Ontario Paper Company Limited, Domtar Kraft and Boxboard Division, Provincial Paper Company Limited, and Thorold Pulp Company are the greatest contributors. The population equivalent has been estimated at 600,000 persons. Also, domestic and industrial wastes are discharged to Beaver Dams Creek from Windle Village, Beaver Wood Fibre Company Limited and Hayes Steel Company Limited as it passes through the Township of Thorold.

The Welland Ship Canal receives sewage plant effluents and inadequately treated domestic wastes from the Town of Port Colborne. Contaminated wastes reach the canal from natural drainage channels and relief sewers in Welland and from drainage of inadequately treated wastes from Fonthill. The use of the canal for disposal of waste water should be curtailed to protect its use for water supply.

Black Creek receives effluents from illegal connections to storm drains in the communities of Stevensville, Ridgeway and Douglastown. Treated domestic sewage and untreated industrial wastes from the Fleet Manufacturing Company Limited are discharged to Frenchman Creek.

5. Conservation and Recreation

The county is well endowed with natural facilities for water sports. The types of recreational uses are extremely varied, ranging from the scenic attractions of Niagara Falls to excellent beach and boating facilities along the shore of Lake Erie. Considerable summer cottage development exists along the whole length of the lake shore.

The Niagara Peninsula Conservation Authority directs conservation activities in the area east of the Grand River basin, west of the Niagara River, north of Lake Erie, and south of the Spencer Creek basin. The authority has appointed an advisory board to select conservation areas with particular reference to recreational activities.

The association of Welland County Conservation Clubs is composed of 14 member clubs interested in various aspects of land and water management.

The Niagara Parks Commission has jurisdiction over approximately 2,800 acres of parkland extending 35 miles along the Niagara River from Lake Erie to Lake Ontario. Water is drawn from the river at several points for lawn irrigation, ornamental fountains, and sanitary purposes.

6. Streamflow

Hydrometric gauging stations have been established on the Welland Ship Canal, the Niagara River, the Welland River and Lake Erie in connection with navigation, hydro electric development, and water resource management. Hydrometric data are collected by various governmental agencies, including the United States Lake Survey; the Canadian Hydrographic Service; the Ontario Hydro Electric Power Commission, the St. Lawrence Seaway Authority; Water Resources Branch; Department of Northern Affairs and National Resources, and the International Niagara Committee.

Under a joint treaty signed by the United States and Canada in 1909, the International Joint Commission was established to regulate the use of all boundary waters and to settle and adjust problems which might arise in this connection. This Commission has the authority to approve all matters affecting flows or water levels with respect to all waters on either side of the International Boundary.

Niagara River

Under a treaty signed in 1950, Canada and the United States equally share the entire flow of the Niagara River. Canada is entitled to an additional 5,000 cfs in recognition of the water diverted to Lake Superior from the Hudson Bay drainage basin. This treaty was designed primarily to safeguard the scenic attractions of Niagara Falls. Under agreement, the flow is maintained at or above 100,000 cfs during daylight hours in the tourist season and at or above 50,000 cfs during the night and at other times of the year. This regulation is strictly enforced. A control weir in the river above the falls has been constructed to permit maximum diversion and optimum flow distribution over the falls. The estimated average discharge available for power purposes amounts to 130,000 cfs. Either country may utilize the unused portion of the other country's authorized diversion.

The flows in the tributaries of the Niagara River are relatively small and the flow in the Niagara River itself is almost entirely dependent on the water level of Lake Erie. The Lake Erie water level records are kept at Buffalo by the United States Lake Survey and at Port Colborne by the Canadian Hydrographic Service. Long-term changes in water level reflect precipitation on the Great Lakes drainage basin. Short-term variations in discharge occur due to wind and ice conditions or atmospheric pressures. Lake Erie is relatively shallow so that wind set up is greater than in deeper lakes.

Average annual flows for the Niagara River are shown in Table 3-2. These figures are determined from the Ashland Avenue Gauge at Lewiston, and the flow measurements made as the water passes through the turbines at the Sir Adam Beck generating stations on the Canadian side and the Pasny Plant on the American side.

TABLE 3-2

NIAGARA RIVER-AVERAGE ANNUAL FLOWS AND DAILY POWER DIVERSIONS

Year	Total Discharge at Queenston cfs	Actual Power Diversions Canada cfs	Actual Power Diversions United States cfs	Total Water Available* cfs
1954	220,290	61,340	32,130	221,140
1955	221,778	90,118	32,053	227,404
1956	207,839	90,808	18,213	214,130
1957	201,458	97,632	12,570	207,736
1958	183,262	89,082	14,849	188,421
1959	197,500	88,717	14,534	202,707
1960	204,300**	94,794	14,514	209,822
1961	187,600 **	81,306	46,260	193,618
1962	not available	62,214	57,192	--
1963	--	56,516	50,756	--

* Figures in the last column include the water diverted for power generation to the DeCew Power plants. ** Provisional flow records.

Welland River

In July 1957, the Water Resources Branch of the Department of Northern Affairs established a gauging station on the Welland River at Warner, in the County of Lincoln. The portion of the drainage basin upstream from this station has an area of 87 square miles, as compared with the 430 square miles of the whole drainage basin. The fluctuation of flows is noted in the following table.

TABLE 3-3

WELLAND RIVER-DISCHARGE RECORDS FOR THE GAUGE AT WARNER

MEAN MONTHLY DISCHARGES IN CFS

Month	1956-57	1957-58	1958-59	1959-60	1960-61
Oct.		0.0	0.1	7.4	0
Nov.		0.1	4.1	36	0.6
Dec.		74	4.2	104	0.2
Jan.		5	115	78	0.1
Feb.		25	123	105	140
Mar.		270	412	72	47.1
Apr.		48	183	468	178
May		3	14	134	24.7
June		0	3.5	101	2.6
July	22	0	nil	0.8	0.8
Aug.	0.2	nil	nil	1.6	14.6
Sept.	0.5	0	nil	0	5.7

The maximum estimated flow was 2,790 cfs registered on April 1, 1962.

Natural streamflow during the summer at Welland is often negligible. A backwater effect from the Chippawa-Queenston Power Canal influences the streamflow at points upstream from the city. The flow in the river at Welland is augmented by the diversion of approximately 250 cfs from the Welland Ship Canal.

Because of the backwater effect, gauging of the river downstream from the City of Welland is difficult. The average discharge to the power canal from the Welland River has been estimated at 540 cfs.

Welland Ship Canal

The total flow through the Welland Ship Canal is controlled and gauged at an intake weir located in a supply channel at Port Colborne. The lock operator can regulate the flow in the canal in order to maintain the required water elevations in the locks. The total average flow entering the Welland Ship Canal is approximately 7,850 cfs. Of this volume, approximately 1,000 cfs are required to operate the canal during the navigation season. The balance is utilized by the DeCew Power plants, industries, and municipalities along the canal. The International Joint Commission limits the amount of water that the St. Lawrence Seaway Authority can lease for power generation.

7. Water Quality

Samples have been obtained annually from the Welland River and its tributaries, the Welland Ship Canal, and Twelve Mile Creek. Summaries of these assessments of the sanitary chemical and bacteriological quality are contained in Tables 3-4, 3-5 and 3-6. The Niagara River is sampled by members of the International Joint Commission to determine phenol concentrations and coliform densities. These results are contained in Table 3-7. Some sampling to assess the extent of stream pollution has also been carried out on the lesser streams and these results are tabulated in Tables 3-6 and 3-8. Regular monthly sampling at several water works systems located on the major watercourses also provides good indication of water quality.

All of the sampling points are shown on Figure 3-1.

Welland River

At times, the Welland River upstream from the City of Welland has contained BOD concentrations and coliform counts in excess of 4.0 ppm and 2,400 coliforms per 100 ml. The water quality deteriorates as the river proceeds through the City of Welland. At mileage point, PW17.4 downstream from all of the major outfalls in the city, the BOD concentrations and coliform counts have been excessive. High coliform counts have usually persisted downstream to the Chippawa-Queenston Power Canal. Excessive iron, and phenol concentrations have also been obtained at mileage point PW14.6 at Port Robinson, which is indicative of considerable industrial wastes pollution. The chemical analyses performed on samples from the Ford Motor Company Limited water works (Chapter 13) downstream have shown frequent high BOD, iron, phenol, free ammonia contents, and excessive turbidities and colour. Although the dilution water added from the Welland Ship Canal aids in assimilating the wastes from the City of Welland, the Welland River is highly polluted downstream from the city.

Thompson's Creek below Cyanamid of Canada Limited is highly polluted with organic industrial wastes showing high BOD, phenol, iron concentrations, and coliform densities.

Lyon's Creek at mileage point PWEL23.2, immediately downstream from the City of Welland Bradley Street pumping station, is grossly polluted. Excessive BOD, phenol, and iron concentrations have been isolated from stream samples, and coliform densities have been similar to those found in raw sewage. High iron, and phenol concentrations persist downstream almost to the confluence with the Welland River.

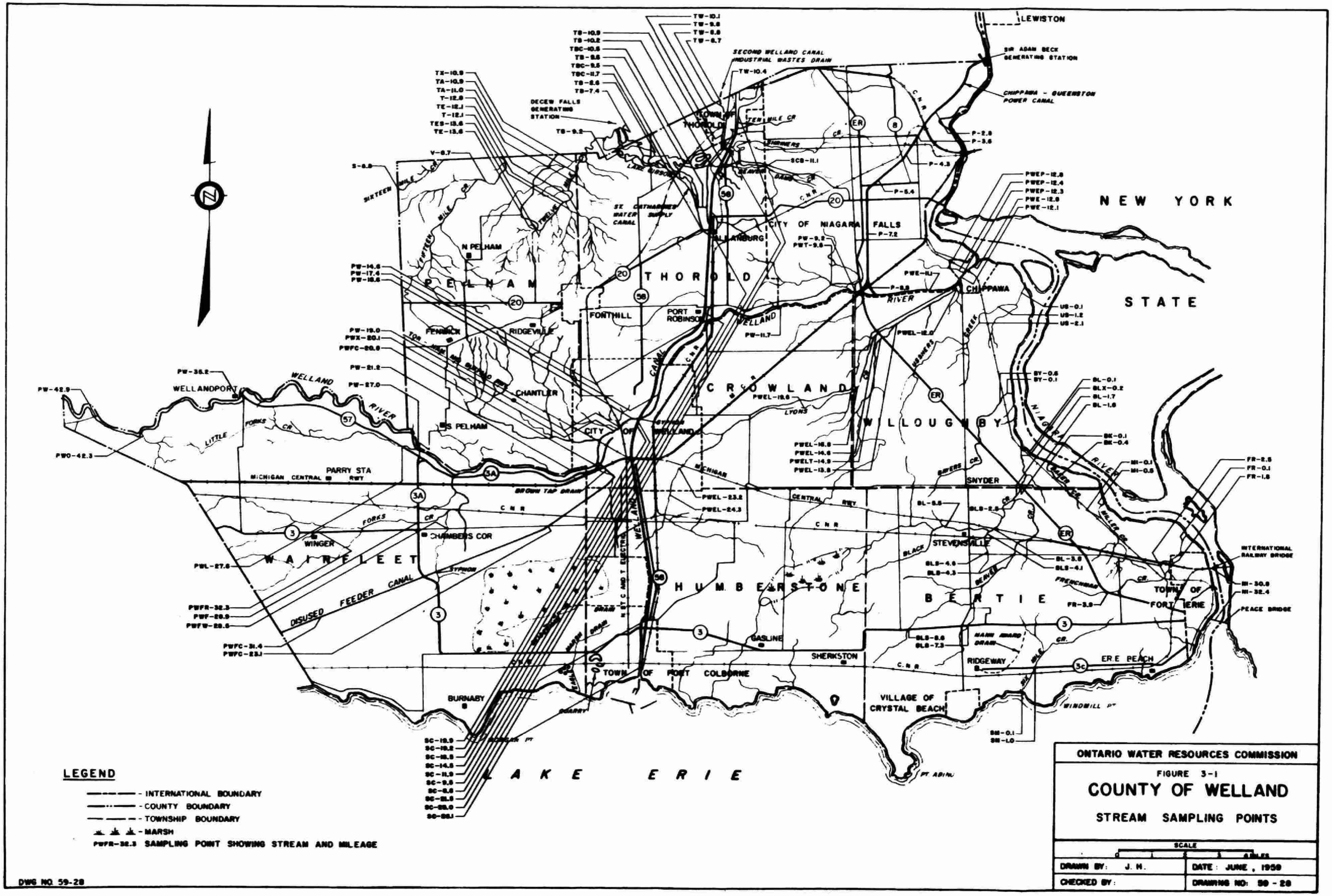
Forks Creek and Little Forks Creek have at times shown excessive BOD concentrations and coliform counts downstream from minor sources of pollution.

The Disused Feeder Canal water quality is generally satisfactory, except for the section known as the Brown Tap Drain in the City of Welland.

The Chippawa-Queenston Power Canal generally has shown satisfactory water quality except at mileage point P2.8 where high coliform densities are obtained due to the discharge of wastes from the Niagara Falls sewage works.

Niagara River

The Niagara River water quality is satisfactory for water supply purposes throughout its length in the county. Routine monthly sampling at the City of Niagara Falls water treatment plant (Chapter 4), has indicated that occasionally high iron concentrations, turbidities, coliform densities, phenol, and free ammonia concentrations are experienced, requiring complete treatment.



LEGEND

- — — - INTERNATIONAL BOUNDARY
- —··— - COUNTY BOUNDARY
- — — — - TOWNSHIP BOUNDARY
- ⁂ ⁂ ⁂ - MARSH
- PWFR-32.3 SAMPLING POINT SHOWING STREAM AND MILEAGE

ONTARIO WATER RESOURCES COMMISSION

FIGURE 3-1

COUNTY OF WELLAND

STREAM SAMPLING POINTS

SCALE 0 1 2 3 4 MILES

DRAWN BY:	J. H.	DATE:	JUNE, 1959
CHECKED BY:		DRAWING NO:	59 - 28

DWG NO. 59-28

The Welland Ship Canal

The Welland Ship Canal is fairly well protected from sources of pollution. The BOD concentrations have been satisfactory throughout its length. Occasionally, coliform densities in excess of 2,400 coliforms per 100 ml have been obtained from the canal. However, regular sampling at the Town of Port Colborne, City of Welland, Town of Thorold, and Township of Thorold water works has shown that the water quality is satisfactory for water supply after complete treatment. The turbidities, and iron concentrations progressively increase as the water flows from Lake Erie towards Lake Ontario.

Twelve Mile Creek

The BOD concentrations in the upper reaches of Twelve Mile Creek have been satisfactory. However, at times, the coliform densities have been high, indicative of agricultural pollution. Beaver Dams Creek at Hwy 58 and at the HEPC pumphouse exhibits excessive BOD concentrations and coliform counts due to septic tank overflows, and industrial waste discharges in the Township of Thorold. The Second Welland Canal industrial waste drain contains highly coloured, malodorous, and putrescible wastes, high in BOD, suspended solids, and coliform density which eventually pollute Twelve Mile Creek downstream from the county boundaries.

Minor Watercourses

Black Creek exhibits fluctuating BOD concentrations, and coliform densities. Agricultural drainage at times raises the BOD concentration in the upper reaches. Downstream from Stevensville and Ridgeway, the OWRC objectives for BOD and coliform count have been exceeded. The high colour in the stream and its polluted condition make Black Creek undesirable as a water supply source. Downstream from the Community of Douglastown, the coliform counts, and BOD concentrations have been frequently above the objectives.

Baker Creek, Bayers Creek, Miller Creek, and Usshers Creek have shown BOD concentrations in excess of 4.0 ppm. These streams flow through rural areas and receive little pollution from domestic sewage. The high BOD can be attributed to the runoff from agricultural lands and decaying natural organic material in the stream beds. Sample results from Fifteen Mile and Sixteen Mile Creeks demonstrate clean stream conditions. Frenchman Creek has indicated high BOD and coliform counts downstream from the Fleet Manufacturing Company Limited outlets.

TABLE 3-4

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
P 2.8	Chippawa Power Canal at Whirlpool Road	June/59	6.6	186	20	4.0	1,200		
		Feb/61	2.3	184	-	2.0	114		
		June/62	1.2	214	-	1.5	23,000		
		May/63	3.1	218	-	5.0	6,000		
		Mar/64	2.7			5.0	3,800	0.0	0.36
P 3.6	Chippawa Power Canal at Stamford Centre Road	June/59	3.6	182	12	6.5	900		
		Feb/61	1.5	190	-	1.0	124		
		May/63	2.7	218		4.5	940		
		Mar/64	2.3			5.0	700	2.0	0.36
P 4.3	Chippawa Power Canal at Portage Road Bridge	June/59	1.1	168	8	6.0	800		
		Feb/61	2.7	182		1.0	79		
		May/63	2.5	214		4.0	1,100		
		Mar/64	2.2			3.5	900	2.0	0.36
P 5.4	Chippawa Power Canal at Dorchester St. (Traffic Circle)	June/59	6.8	166	20	3.5	700		
		Feb/61	2.4	186		1.0	63		
		May/63	3.0	216		6.0	320		
		Mar/64	2.9			4.0	1,200	0.0	0.36

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
P 7.2	Chippawa Power Canal at McLeod Avenue	June/59	0.9	172	4	4.3	300		
		Feb/61	1.7	190		2.0	47		
		May/63	2.3	210		9.0	1,150		
		Mar/64	2.5			4.5	1,900	3.0	0.36
P 8.8	Chippawa Power Canal at Junction Welland R. at M.C.R.	June/59	0.8	180	4	3.7	500		
		Feb/61	2.5	182		1.0	84		
		June/62	1.4	228		1.7	>15,000		
		May/63	3.1	196		4.0	980		
		Mar/64	2.3			4.0	1,400	3.0	0.30
PWE 11.1	Welland R. (East) opposite golf course west of Stanley Rd.	June/59	0.9	186	6	8.1	130		
		Feb/61	3.8	184		3.0	13,800		
		June/62	1.6	240		3.8	24,300		
		May/63	2.9	196		7.0	42,000		
		Sept/63	2.2	198	11		41,000		
PWE 11.4	Welland R. east of Stanley Road	Feb/61	2.6	198		2.0	58		
		June/62	0.6	220		1.3	3,800		
		May/63	2.2	180		6.5	270		
		Sept/63	1.6	186	2		1,300		

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PWEL 12.0	Lyons Cr. just above junction at bridge	June/59	2.1	204	4	22	150		
		Feb/61	2.0	226		3	1		
		June/62	1.1	222		1.8	3,000		
		May/63	2.8	240		11.5	33,000		
		Sept/63	1.0	186	2		1,600	0	0.12
PWEL 13.8	Lyons Cr. at Conc. Rd.5 Willoughby Township	June/59	3.8	242	12	24	50		
		Feb/61	6.0	408	54		20		
		June/62	1.9	312		13.0	150		
		May/63	2.8	364		27.0	790		
		Sept/63	1.0	280	3			3	0.60
PWELT 14.9	Tee Cr. at Conc. Rd. 6 Willoughby Township	June/59	3.7	288	18	21	100		
		Feb/61	14.0	1178	122		30		
		June/62	1.8	332		3.8	4,000		
		May/63	2.2	226		26	1,170		
		Sept/63	1.7	296	10		120		
PWEL 14.6	Lyons Cr. at Conc. Rd. 6 Willoughby Twp.	June/59	2.0	274	28	25	20		
		Feb/61	16.0	428	58		50		
		June/62	1.9	328		2.8	3,000		
		May/63	2.3	364		24	230		
		Sept/63	1.6	296	7		150	12	0.72

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PWEL 16.8	Lyon's Cr. at Twp. Line-Crowland-Willoughby	June/59	1.3	248	16	15	90		
		Feb /61	6.0	452	42		20		
		June/62	1.8	374		6.5	1,500		2.25
		May /63	1.4	366		2.6	310		
		Sept/63	1.3	284	2		410	2	0.36
PWEL 19.6	Lyon's Cr. at side road ½ mile below Cooks Mills	June/59	1.6	294	4	15	40		
		Feb /61	7.6	312		10	750		2.6
		June/62	5.6	318	29		9,000		
		May /63	2.3	318		2.6	90		
		Sept/63	1.9	290	4		460	9	0.9
PWEL 23.2	Lyon's Cr. at Ontario Road	June/59	7.6	342	8	25	190,000		
		Feb /61	21.0	398		37	5,000		11.8
		June/62	7.0	474	28		247,000	3	4.4
		May /63	2.8	588		110	16,000,000	8	35.0
		Sept/63	6.0	246	13		>150,000	20	2.64
PWELB 24.0	Ditch downstream from Bradley St. pumping station-Welland	Sept/63	65	508	119			30	5.5

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PWEL 24.2	Lyon's Cr. at South St.	Sept/63	8.8	350	20		53,000	16	4.5
PWE 12.1	Welland R. east opposite Sodom Rd. west end of Chippawa	June/59	1.2	214	6	3	500		
		Feb /61	1.5	154		3	3		
		June/62	1.0	208		1.5	5,100		
		May /63	2.4	144		5.0	290		
		Sept/63	1.2	190	2		800		
PWE 12.8	Welland R. east at bridge above mouth of Niagara River	June/59	1.5	198	44	7	1,000		
		Feb /61	2.8	178		1	45		
		June/62	1.1	194		1.3	600		
		May /63	2.5	136		4.0	200		
		Sept/63	1.2	188	2		3,800		
PW 9.2	Welland R. west at Crowland-Willoughby Line	June/59	2.8	190	4	16	300		
		Feb /61	4.2	220		5	5,000		
		June/62	2.2	196		1.7	14,100	2.0	
		May /63	2.6	200		5.5	730		
		Sept/63	1.2	188	2		3,800		
		Apr /64						5.0	3.9
PWT 9.8	Thompson's Cr. at Port Robinson Rd. just above junction	June/59	1.6	336	50	26	66		
		Feb /61	9.0	608	406		30		
		June/62	21.0	594	53		239,000		
		May /63	2.0	1566	300	525	11,000	10	
		Sept/63	19.0	1640	220		<100,000	0	

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PWT 10.8	Thompson's Cr. just below Cyanamid plant	June/59	12.0	302	168		20		
		June/62	205	824	195		24,000,000		
		May/63	2.4	2080	300		90	12	18
		Sept/63	28	730	106		2,300	0	
PW 11.7	Welland River west opposite sideroad 2 3/4 miles west of power canal	June/59	2.8	200	10	12	300		
		Feb/61	3.7	198		2	500		
		June/62	2.8	292	4.5		8,000		
		May/63	2.0	1242		250	< 10	6	3.0
		Sept/63	4.6	246	27		5,000		
PW 14.6	Welland River west at bridge, Port Robinson just east of ship canal	June/59	1.9	196	16	7	400		
		Feb/61	3.2	194		2	510		
		June/62	1.8	272		34	41,000		
		May/63	3.7	236		21	80,000		
		Sept/63	2.6	220	30		31,000		
		Mar/64		210					13.0
PW 17.4	Welland River north of Dawns Drive - Welland	June/59	7.1	262	74	34	3,000		
		Feb/61	4.9	182		2	5,800		
		June/62	2.8	240		7.0	176,000		
		May/63	6.0	260		11.0	113,000		
		Sept/63	25	452	220		410,000		

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PW 18.6	Welland River west at bridge just west of ship canal	June/59	3.0	216	26	33.0	180,000		
		Feb/61	8.0	216		2	97,000		
		June/62	1.1	212		27.0	>1,500,000		
		May/63	3.8	236		6.5	131,000		
		Sept/63	2.2	230	22		210,000		
PWX 19.9	Coyle Cr. at bridge just above mouth	June/59	2.8	308	56		1,000		
		Feb/61	10	324		14	60		
		June/62	3.2	316	93		25,000		
		May/63	3.5	320		26	60,000		
		Sept/63	1.6	246	47		100,000		
PWFC 20.8	Disused Feeder Canal just above outlet to Welland River (Brown Tap Drain)	May/61	2.0	312	12	9	1,020		
		Apr/64	33.0	378	44		1,000		
PW 21.2	Welland River west opposite Pelham Twp. - Welland line	June/59	14	334	64	87	50,000		
		Feb/61	5.6	264		2	7,700		
		June/62	2.8	300		45	39,000		
		May/63	4.4	396		65	37,000		
		Sept/63	2.6	342	54		6,000		

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PWFC 23.1	Disused Feeder Canal at Hwy 3	May/61	6.0	290	40	43	20		
PWF 25.6	Forks Cr. at Hwy #3A	July/59	9.2	284	46		100		
		Feb/61	5.3	396		3	39		
		June/62	2.0	322		43	25,000		
		May/63	3.2	340		53	360		
PWFW 28.5	Wainfleet Br. Forks Cr. at Conc. Rd. 4 & 5 - Wainfleet Township	June/59	3.6	560	70		10,000		
		Feb/61	14.0	798		10	5		
		June/62	4.4	436		48	109,000		
		May/63	3.4	460		59	5,000		
PWF 28.9	Forks Cr. at Hwy #3A just north of Chambers Cor.	June/59	5.0	432	70		100		
		Feb/61	30	566		34	110		
		June/62	2.6	462		48	61,000		
		May/63	2.8	490		50	150		
		Sept/63	2.6	410	23		100		
PWFC 31.4	Disused Feeder Canal at sideroad crossing south of Winger	May/61	3.6	244	26	19	52		

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PWFR 32.3	Branch from Winger	June/59	95	4326	72		<10,000,000		
	(just below) beside	Feb/61	1,000	4364	196		700		
	Hwy #3	June/62	3.6	348		9.0	66,000		
		May/63	3.1	792		8.0	5,000		
PW 27.0	Welland River just	June/59	3.2	286	38	58	71		
	opposite junction	Feb/61	4.0	342		5	2,500		
	of #3A and #57	June/62	1.8	328		45	10,000		
	Hwys	May/63	2.5	348		45	1,010		
		Sept/63	3.0	346	20		900		
PW 35.2	Welland River ½	June/59	5	356	26	42	600,000		
	mile below Welland-	Feb/61	6.5	570		4	0		
	port beside Hwy #57	June/62	2.6	360		43	5,000		
		May/63	2.8	282		17	410		
		Sept/63	1.8	380	21		180		
		Apr/64						3.3	9.8
PWO 42.3	Oswego Cr. at Rd.	June/59	10	372	48	70	100		
	just above junction	Feb/61	6.7	1424		8	20		
		June/62	4.8	466		42	8,000		
		May/63	4.1	342		18	380		
		Sept/63	2.8	428	39		210		

TABLE 3-4 - Cont'd

STREAM SAMPLE RESULTS-WELLAND RIVER AND TRIBUTARIES

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PW 42.9	Welland River at Talbot Rd. just west of Pt. Davidson Station	June/59	5	342	32	65	36		
		Feb/61	9.4	1332		6	20		
		June/62	4.8	520		50	11,000		
		May/63	5.0	414		53	1,000		
		Sept/63	3.2	616	67		600		
PW 52.2	Welland River at Warner on Smithville-Canborough Rd.	Feb/61	8.0	5308		9	20		
		June/62	2.0	722		41.0	17,000		
		May/63	2.8	466		13.0	320		
		Sept/63	1.8	988	7		1,500		

TABLE 3-5

STREAM SAMPLE RESULTS-WELLAND SHIP CANAL

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)
SC 14.5	Welland Canal	Aug 9/60	1.2				10	340	
	at Port Robinson	Jan 12/61	2.2	174			10	170	
	bridge	June 18/62	0.6	206			7.5	800	
		Nov 13/63	2.2	208	6	202		460	
SC 18.5	Welland Canal	Aug 9/60	1.5				7	360	
	at Main St.	June 18/62	1.1	176			5.5	4,000	
	bridge, Welland	Nov 13/63	1.9	214	12	202		570	4
SC 19.2	Welland Canal at	June 18/62	1.6	184			5.0	15,000	
	Welland Lincoln	Nov 13/63	2.2	224	11	213		430	0
	St. bridge								
SC 19.9	Welland Canal at	Aug 9/60	2.3				7	150	
	Crowland bridge	Jan 12/61	2.7	182			11	90	
		June 18/62	1.3	196			6	14,000	
		Nov 13/63	2.0	194	10	184		310	0
SC 21.5	Welland Canal at	Aug 9/60	1.3				4	1,470	
	Welland junction	Jan 12/61	2.0	180			11	111	
	bridge	Jan 18/62	1.1	200			2.3	390	
		Nov 13/63	1.8	234	7	227		650	

TABLE 3-5 Cont'd

STREAM SAMPLE RESULTS-WELLAND SHIP CANAL

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)
SC 25.0	Welland Canal at Main St. bridge, Port Colborne	Aug 9/60	1.6				6	114,000	
		Jan 12/61	3.6	194			8	108	
		June 18/62	1.0	220			4.2	7,000	
		Nov 13/63	1.8	224	3	221		830	
SC 26.1	Welland Canal at Clarence St. bridge, Port Colborne	Aug 9/60	1.3				3	70	
		June 18/62	0.9	186			1.8	800	
		Nov 13/63	1.7	210	2	208		70	
SC 8.8	Welland Canal at Thorold, Peter Street bridge	Aug 9/60	1.1				19	70	
		June 18/62	1.4	216			12.5	330	
		Nov 13/63	1.7	236	22	214		530	
SC 9.5	Welland Canal at Thorold Street bridge	Aug 9/60	1.2				10	240	
		Jan 12/61	3.0	176			9	60	
		June 18/62	0.9	216			13.5	8,000	
		Nov 13/63	1.9	224	13	211		470	
SC 11.9	Welland Canal at Allanburg bridge	Aug 9/60	1.6				11	390	
		Jan 12/61	1.6	176			12	190	
		June 18/62	0.7	194			7.5	270	
		Nov 13/63	1.8	230	10	220		510	

TABLE 3-6

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

TWELVE MILE CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
				Total	Susp.	Diss.				
TB 7.4	Beaver Dams Cr. DeCew HEPC power house	May /61	3.0	236	--	--	6.0	3		
		Oct /61	1.2	248	--		9.0	4,100		
		June/62	<4*	228	--		11.0	830		
		Jan /63	3.2	210	--		5.0	340		
TB 8.6	Beaver Dams Cr. Gibson Lake W. at Merrittville Rd.	June/59	6.0	242			16.0	<10,000		
		May /61	3.1	228			6.0	9		
		Oct /61	1.6	242			5.0	1,120		
		June/62	<4	250			9.5	4,000		
		Jan /63	--	--	--	--	--	530		
TW 8.7	Second Welland Canal at Thorold-St. Catharines Townline Rd.	Mar /64	230	1530	252	1278		1,900,000	2.12	7.9
TW 8.8	Second Welland Canal at foot bridge 200 yards below Thorold Pulp Co. (no longer exists)	June/59	113	1080	736	344		10,000,000		
		Oct /61	180	1020	242	778		850,000		
		June/62	--	1994	--	--	125	2,470,000		
		Jan /63	175	1164	190	974		98,000		
		Mar /64								

TABLE 3-6 - Cont'd

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

TWELVE MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
TD 9.2	DeCew Falls at road above falls	May /61	2.6	246	--	--	4	8		
		Oct /61	1.5	222			6	10		
		June/62	<4*	196			3.5	4,300		
		Jan /63	3.4	208			5.0	160		
TBC 9.5	Beaver Dams Cr. canal branch at Beaver Dams Rd.	May /61	2.8	250	--	--	6	6		
		Oct /61	1.3	234			8	1,340		
		June/62	<4*	214			9.5	230		
		Jan /63	2.2	224			3.8	78		
TB 9.6	Beaver Dams Cr. at Beaver Dams Rd.	May /61	9.0	246			9.0	43		
		Oct /61	8.0	248			6.0	1470		
		June/62		244			11.5	870		
		Jan /63	3.6	248			7.5	560		
TD 9.8	Twelve Mile Cr. DeCew Falls branch at Greenbridge Rd.	Oct /61	1.0	222			7.0	670		
		June/62	<4*	198			3.1	400		

TABLE 3-6 - Cont'd

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

TWELVE MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
TW 9.8	Second Welland Canal at Lyndon St. bridge	Jan /63	160	1134	115	1019		109,000		
		Mar /64	210	1468	80	1388		3,700,000	3.45	7.2
TBE 10.1	Twelve Mile Cr. lake tributary to Gibson Lake at road to Beaver Dams Village	Jan /63	2.4	280			5.5	230,000		
TW 10.1	Second Welland Canal at Beaver Dams Road	May /61	145	1072	192	880		3,000		
		Oct /61	140	986	118	868		410,000		
		June/62		2168			53	2,570,000		
		Jan /63	195	1214	122	1092		88		
		Mar /64	205	1544	100	1444		150,000	3.75	7.4
TB 10.2	Beaver Dams Cr. at HEPC pumphouse	May /61	84	480	80	400		219,000		
		Oct /61	44	360			17	930		
		June/62		454			65	60,000		
		Jan /63						5,000		

TABLE 3-6 - Cont'd

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

TWELVE MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
TW 10.4	Second Welland Canal outlet from Ship Canal	Jan /63	<4*	212			9.0	12,000		
		Mar /64	2.0	194	3.0	191		20	0.15	8.0
TBC 10.5	Beaver Dams Cr. at dam at Third Welland Canal	June/62	<4*	222			10.5	330		
TB 10.9	Beaver Dams Cr. at Hwy 58	June/59	40	290	36	259		740,000		
		May /61	29	458	68	390		34,000		
		Oct /61	80	488			22	6,000		
		June/62		264			5.5	11,100		
		Jan /63	58	298	30	268		1,320		
TX 10.4	Twelve Mile Cr. west branch at Pelham Thorold Twp. townline	June/59	2.6	480			5.0	10,000		
		May /61	2.1	420			3.0	55		
		Oct /61	1.5	528			2.0	310		
		June/62	<4*	426			4.0	1,380		

TABLE 3-6 - Cont'd

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

TWELVE MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
				Total	Susp.	Diss.				
TA 10.9	Twelve Mile Cr.	June/59	1.3	360			7.0	10,000		
	W.B. at Pelham-	May /61	2.2	400			7.0	284		
	Thorold Twp.	Oct /61	1.8	348			1.0	99		
	townline	June/62	<4*	408			27.0	3,600		
TA 11.0	Twelve Mile Cr.	May /61	1.5	408			21	47		
	Aerial Beacon	Oct /61	2.1	414			2.0	124		
	Branch just above junction	June/62	<4*	560			3.1	2,100		
TBC 11.7	Ship Canal diversion	Oct/61	1.4	244			7	1,060		
	at Hwy 20	June/62	2.2	224			3.8	78		
		Jan /63	-	234			12.5	9,000		
TE 12.1	Twelve Mile Cr.	June/59	1.8	360			4.0	20,000		
	Effingham Branch	May /61	2.2	330			3.0	193		
	just above junction	Oct /61	2.2	326			1.0	109		
	by St. John's W. Allanburg Road	June/62	<4*	320			3.8	12,000		

TABLE 3-6 - Cont'd

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

TWELVE MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
				Total	Susp.	Diss.				
T 12.1	Twelve Mile Cr. just above junction Effingham Branch	June/59	1.7	346			9.0	< 10,000		
		May/61	2.3	356			5.0	131		
		Oct /61	2.3	396			1.0	22		
		June/62	<4*	382			3.8	970		
T 12.8	Twelve Mile Cr. St. John's W. at St. John's West Fonthill Road	June/59	1.9	336	--	--	4.0	20,000		
		May /61	2.2	368			2.0	145		
		Oct /61	1.6	386			1.0	129		
		June/62	<4*	372			4.0	1,500		
TE 12.8	Twelve Mile Cr. Effingham Branch in Commercial Park	June/62	<4*	322			6.0	12,000		
T 13.0	Twelve Mile Cr. East Effingham Branch just above junction at road to St. John's W.	Oct /61	2.0	312			1.0	236		

TABLE 3-6 - Cont'd

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

TWELVE MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
TE 13.4	Twelve Mile Cr. Effingham Branch at Effingham, St. John's W. Road	May /61	2.0	346			2.0	91		
		Oct /61	2.2	314			2.0	153		
		June/62	<4*	334			6.5	51,000		
TE 13.6	Twelve Mile Cr. Effingham Branch at Pelham Road	June/59	1.5	354			13.0	10,000		
		May /61	2.0	330			3.0	72		
		Oct /61	1.7	326			2.0	300		
		June/62	<4*	326			8.0	59,000		
		Jan /63	3.0	322			5.0	280		
TES 13.6	Twelve Mile Cr. south branch just above junction	June/59	1.6	686			13.0	20,000		
		May /61	1.5	346			1.0	3		
		Oct /61	790	842			14.0	4,000		
		June/62	<4*	360			1.4	198		

* denotes estimated BOD

TABLE 3-6 - Cont'd

STREAM SAMPLE RESULTS-STREAMS TRIBUTARY TO LAKE ONTARIO

FIFTEEN MILE CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
V 8.7	Fifteen Mile Cr. at sideroad east of North Pelham	Sept/61	0.2	338	2	336		70		
V 9.5	Fifteen Mile Cr. at road between Conc. 2 & 3 Pelham Twp.	Sept/61	1.6	414	6	408		250		
V 12.3	Fifteen Mile Cr. at conc. road through Silverdale	Sept/61	0.8	426	84	342		210		

SIXTEEN MILE CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH at Lab
S 5.2	Sixteen Mile Cr. at Rockway Rd. Conc. 7 Louth Twp.	Sept/61	1.9	400	22	378		152		
S 8.8	Sixteen Mile Cr. at Pelham - Gainsborough Townlines	Aug /60	2.0				3	140		
		Sept/61	3.5	488	42	446		230		

TABLE 3-7

STREAM SAMPLE RESULTS-NIAGARA RIVER INTERNATIONAL JOINT COMMISSION

Sampling Point No.	Description		Coliform Concentrations Coliforms MPN per 100 ml			Phenols (ppb)			
			1952-6	1961	1962	1948-49	1956	1959	1962
Ni 32.4	Range across	Med.	930	930	-				
	Niagara R. 1000'	Max.	23,000	9,300	23				
	from east shore	Min.	43	230	-				
	at Peace Bridge	No.	15	7	1				
Ni 30.8	Range across	Med.	-			4	5	4	0
	Niagara R. 1700'	Max.	-	17	930	50	5	10	0
	from east shore	Min.	-	-	-	0	5	0	0
	at International	No.	-	1	1	36	1	20	13
	Railway Bridge								

TABLE 3-8

STREAM SAMPLE RESULTS-MINOR STREAMS TRIBUTARY TO THE NIAGARA RIVER

USSHERS CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
U 0.1	Usshers Cr. at river road	July /59	1.6	190			3.0				
		May /61	1.8	226			4.0	30			
U 1.2	Usshers Cr. at sideroad 1¼ miles above Niagara River	July /59	3.2	262	44	218					
		May /61	4.4	280	40	240		20			
U 2.9	Usshers Cr. at Sodom Rd.	July /59	4.0	330	64	266					
		May /61	5.2	280	32	248		32			
	BAYERS CREEK										
BY 0.1	Bayers Cr. just above Niagara River	July /59	0.9	194			15.0				
		May /61	2.3	236			7.0	10			
BY 0.6	Bayers Cr. at first sideroad above mouth	July /59	2.8	408			115				
		May /61	6.0	380	80	300		30			

TABLE 3-8 - Cont'd

STREAM SAMPLE RESULTS-MINOR STREAMS TRIBUTARY TO THE NIAGARA RIVER

BLACK CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
BL 0.1	Black Cr. at	July/59	8.6	228			24	< 10,000			
	river road near	Aug /60	2.0				7	360			
	mouth at Niagara	May /61	9.0	474	92	382		1,730			
	River	May /63	3.6	542			84	7,000	2.7	0.0	250
BLX 0.2	Black Cr. improved	May /61	1.7	402	64	338		2,010			
	watercourse	May /63	4.5	334			29	10,600	1.8	0.0	145
BL 1.6	Black Cr. at	July/59	9.6	312	24	288		1,000,000			
	Queen Elizabeth	Aug /60	5.0				78	700			
	Hwy	May /61	1.8	464	92	372		1,120			
		May /63	3.6	578			110	4,900	4.8	0.0	130
BL 1.7	Black Cr. Douglas-	Aug /60	5.0				70	400			
	town water works	July/61	6.0	650	122	528		1,410			110
	intake	Apr /63						8,000			
BLB 2.5	Beaver Cr. at	July/59	6.8	822	12	810		< 10,000			
	first sideroad	Aug /60	7.0				48	31			
	above confluence	June/61	0.5	724			1.0	140			
	with Black Cr.	May /63	1.4	698			2.3	2,700	0.5	0.0	140

TABLE 3-8 - Cont'd

STREAM SAMPLE RESULTS-MINOR STREAMS TRIBUTARY TO THE NIAGARA RIVER

BLACK CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
BL 3.6	Black Cr. at sideroad below junction of south branch	July/61	4.4	714	134	580	--	210			200
BL 3.8	Black Cr. at railway bridge below junction of south branch	Aug /60	14.0				62	700			
		July/61	16.0	684	96	588		240			200
BL 4.0	Black Cr. south branch Conc. 10 Bertie Township	July/59	25.0	676	94	582		< 10,000			
		Aug /60	6.0				81	430			
		July/61	4.0	674	114	560		480			
		Aug /60	6.0				81	430			
		May /63	2.0	518			74	7,700	2.7	0.0	260
BL 4.1	Black Cr. just above junction of south branch	Aug /60	5.0				79	500			
		July/61	1.6	714	140	574		260			
		Apr /62						38,000			
		May /63	1.0	480			62	110,000	3.2	0.0	215

TABLE 3-8 - Cont'd

STREAM SAMPLE RESULTS-MINOR STREAMS TRIBUTARY TO THE NIAGARA RIVER

BLACK CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
				Total	Susp.	Diss.					
BLB 4.3	Beaver Cr.	July/59	11.0	584	26	558		<10,000			
	Stevensville -	May /61	1.0	652	8	644		113			
	Bowen Road	May /63	1.4	570			2.8	3,800	0.5	0.0	65
BLS 4.8	Black Cr. south	July/59	11.0	2452	18	2434		<10,000			
	branch at Bowen	Aug /60	14.0				42	4,000			
	Road	May /61	7.0	1392	18	1374		610			
		May /63	2.6	1342			29	5,000	1.8	0.0	110
BL 5.5	Black Cr. first	July/59	18.0	530	52	478		<10,000			
	conc. north of	Aug /60	12.0				51	980			
	Stevensville	May /61	11.0	440	20	420		570			
		July/61	2.4	506	58	448		230			150
		Apr /62						52			
		May /63	5.2	430				310	2.0	0.0	215
BLB 7.3	Beaver Cr. at	July/59	2.3	2240			17	58,000			
	Old Garrison Rd.	May /61	6.0	1136				7,000			
		May /63	1.2	1166			1.0	7,600	0.35	0.0	60

TABLE 3-8 - Cont'd

STREAM SAMPLE RESULTS-MINOR STREAMS TRIBUTARY TO THE NIAGARA RIVER

BLACK CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
				Total	Susp.	Diss.					
BLB 7.6	Beaver Cr. conc. road between Conc. 15 & 16 Bertie Township	May /63	2.8	676			31	2,700	2.8	0.0	45
BLS 8.6	Black Cr. south branch at Old Garrison Rd.	July/59	15.0	398	76	322		40,000			
		May /61	5.2	330	62	268		860			
		May /63	3.2	300			48	4,100	2.2	0.0	210

BAKER CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
				Total	Susp.	Diss.					
BK 0.1	Baker Cr. at river road	July/59	0.9	208	--	--	16	--			
		May /61	5.6	228	40	188	--	370			
BK 0.4	Baker Cr. at road 0.4 miles from mouth	July/59	1.8	204	--	--	23	--			
		May /61	3.0	204	24	180	--	20			

TABLE 3-8 - Cont'd

STREAM SAMPLE RESULTS-MINOR STREAMS TRIBUTARY TO THE NIAGARA RIVER

MILLER CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
				Total	Susp.	Diss.					
MI 0.1	Miller Cr. at river road	July/59	1.6	190	--	--	10				
		June/61	5.0	342			6.0	350			
MI 0.5	Miller Cr. at road ½ mile above mouth	July/59	3.8	360			91				
		June/61	2.0	920			17	450			
				FRENCHMAN CREEK							
F 0.1	Frenchman Cr. at river road	June/59	3.4	432	8	424	18	3,400			
		Aug /60	2.1				6	50			
		May /61	2.8	828			18	20			
F 1.8	Frenchman Cr. at road south of golf course	June/59	4.9	502	12	490	13	152			
		Aug /60	1.9				8	17,000			
		May /61	4.0	486			5	300			

TABLE 3-8 - Cont'd

STREAM SAMPLE RESULTS-MINOR STREAMS TRIBUTARY TO THE NIAGARA RIVER

FRENCHMAN CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Lead as Pb	Colour in Hazen Units
F 2.5	Frenchman Cr.	June/59	7.4	276	34	242	18	0			
	at Conc. Rd. 2	Aug /60	4.1				13	510			
	Bertie Twp.	May /61	3.6	314			7	17			
F 3.9	Frenchman Cr.	June/59	3.4	340	32	308	82	>150			
	at Queen	May /61	2.8	314			7.0	190			
	Elizabeth Hwy										

CHAPTER 4

CITY OF NIAGARA FALLS

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CHAPTER 4

CITY OF NIAGARA FALLS

I GENERAL

The City of Niagara Falls is located on the west bank of the Niagara River immediately north of the Welland River. The major portion of the developed area drains to the Niagara River, either directly, or indirectly via the Welland River and the Chippawa-Queenston Power Canal. The north-western undeveloped portion drains to the Welland Ship Canal via Ten Mile Creek, Shriner's Creek, and Beaver Dams Creek. The natural drainage pattern has been disrupted by the construction of the HEPC power canal and tunnels which operate the extensive generating facilities.

The 1963 assessed population is 53,941. This figure is considerably augmented during the summer months by the thriving tourist industry.

Many varied industries, including food and chemical processing, and other manufacturing industries, are located within the city.

II WATER SUPPLIES

1. Municipal

(a) Sources

The water department of the City of Niagara Falls owns and operates a water works system obtaining Niagara River water from an intake located in the Welland River, near its original mouth. The intake structure is located downstream from the power canal intake control works.

(b) Treatment Works

The City of Niagara Falls Water Filtration Plant is located within the Village of Chippawa. Treatment consists of coarse screening, pre-chlorination, coagulation, settling, filtration and post-chlorination. Alum is applied for coagulation purposes when the turbidity is excessive. The capacity of the intake structure is 40 mgd. The low and high lift pumping capacities are 32 mgd each. The filtration or limiting capacity of the works is 20.0 mgd.

(c) Water Consumption

During 1963, the average daily pumpage was 8.36 mgd and the maximum daily pumpage was 17.1 mgd. The average daily per capita consumption was approximately 155 gpcpd. The average daily pumpage was a minimum of 6.43 mgd during December and a maximum of 11.7 mgd during July. An average of 388,000 gpd were supplied to the Village of Chippawa and an average of 38,000 gpd were supplied to Niagara Township.

(d) Water Quality

The treated water bacteriological quality was satisfactory during 1963 as indicated by 23 samples from the filtration plant which all contained zero organisms per 100 ml. Of the 22 raw water samples submitted to the OWRC during 1963, 13 contained coliform organisms ranging from 21 to 11,200 organisms per 100 ml. A minimum of 54 samples per month should be obtained from the distribution system for bacteriological examination.

The chemical water quality of the municipal supply is shown in the following table summarizing the results of samples submitted to the OWRC during 1963.

	No. of	Raw Water			Treated Water		
	Samples	Avg.	Min.	Max.	Avg.	Min.	Max.
Hardness as CaCO3	16	129	120	138	129	122	138
Alkalinity as CaCO3	16	99	92	102	98	92	102
Iron as Fe	16	0.37	0.19	1.56	0.17	0.0	0.43
Chloride as Cl	16	24	22	26	24	22	27
pH at Lab	16	8.1	6.2	8.5	8.0	7.8	8.4
Colour in Hazen Units	36	<5	<5	8	<5	<5	8
Turbidity in Silica Units	17	3.7	1.1	10.0	2.9	0.5	11.0
Phenol ppb	17	4.1	0	25	1.8	0	8.0
Free Ammonia as N	36	0.10	Trace	0.26	0.12	.01	0.32

The water is moderately hard and the raw and treated water indicate fluctuating iron, turbidity, phenol, and free ammonia contents. At most times the iron content is reduced by treatment below the 0.3 ppm recommended limit. However, the phenol concentration is for the most part uneffected by treatment and concentrations in excess of the recommended 1.0 ppb have been contained in the treated water. The high phenol concentrations could cause taste and odour problems. Occasionally the treated water turbidity has exceeded 5.0 ppm.

The organic content of the water is reflected in the high free ammonia concentrations in both the raw and treated water.

Algae growths during the summer months necessitate more frequent cleaning of the wet well screens. However, no taste or odour problems in the treated water have been experienced.

(e) Distribution

The area served by water is outlined in Figure 4-1. In addition to areas within Niagara Falls, water is sold to Niagara Township in Lincoln County for the Bevan Heights Subdivision (17 services) and the Police Village of Queenston (238 services). A separate 12-inch diameter main from the filtration plant serves the 1,139 services in the Village of Chippawa. Twenty-three services in the Township of Willoughby are supplied with water from the Chippawa system. B.F. Gooderich in the Township of Thorold also is served.

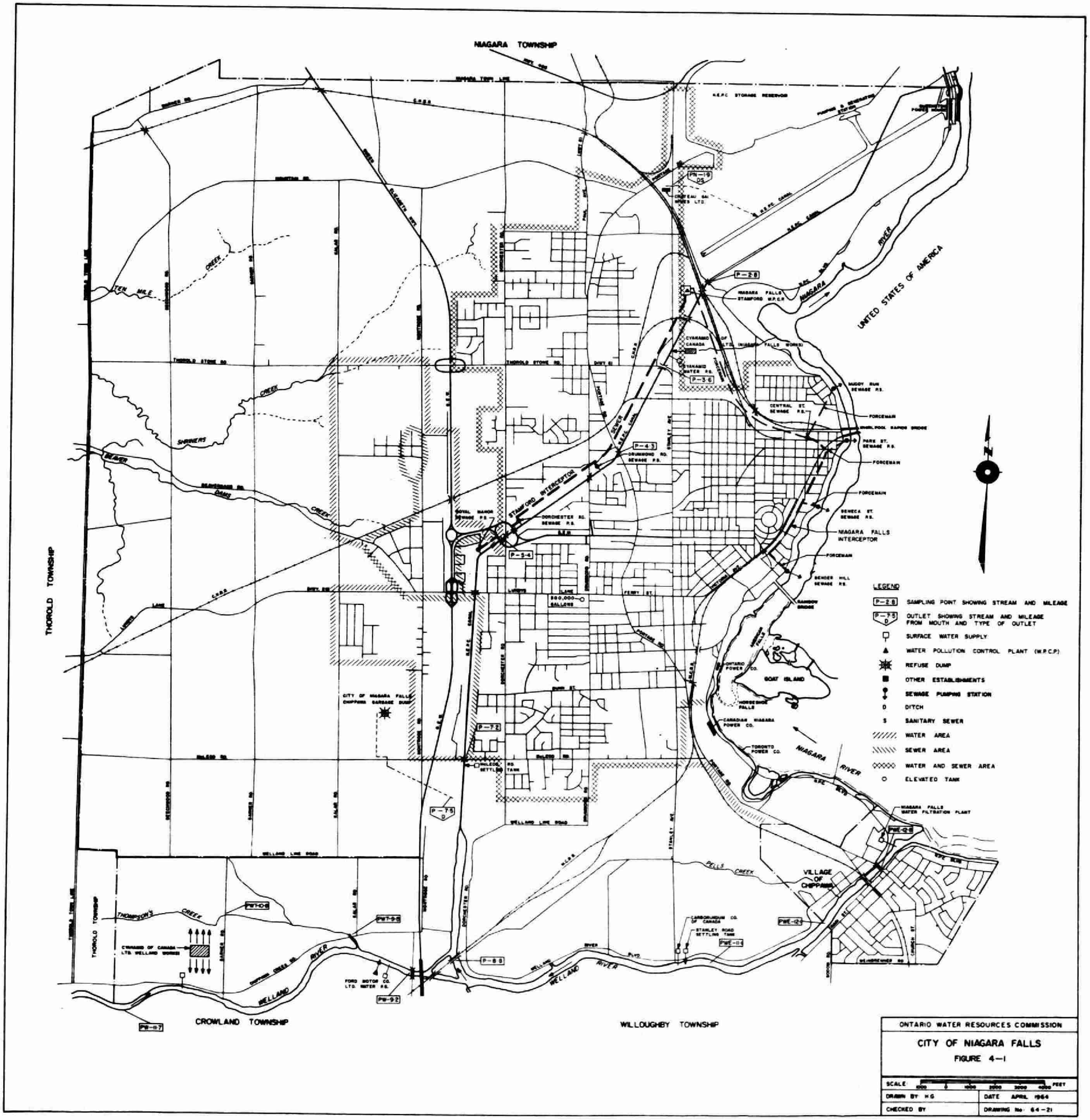
The distribution network consists of 164.0 miles of mains ranging in diameter from 30 inches down to less than 4 inches in diameter. Approximately 16 per cent of the watermains have diameters less than 4 inches. These should gradually be replaced by mains 6 inches in diameter or larger as required for fire supply and pressure. There are 1,157 hydrants on the system of which 152 are installed on 4-inch mains.

Within the city 13,680 domestic services, 940 commercial services and 59 industrial services are supplied with municipal water. Only 955 customers are metered.

Storage consists of two ground storage reservoirs at the water filtration plant, which have a combined capacity of 1.25 million gallons and an elevated steel tank with a capacity of 500,000 gallons. Storage is insufficient to meet fire requirements.

2. Private Water Supplies

There are four private industrial water supplies located in the City of Niagara Falls. The details of the systems are outlined in the following table.



ONTARIO WATER RESOURCES COMMISSION

CITY OF NIAGARA FALLS

FIGURE 4—1

DRAWN BY H.G.

DATE APRIL 1964

CHECKED BY

DRAWING No. 64—21

Industry	Source	Treatment	Pumpage mgd	Use
The Canadian Carborundum Co. Ltd.	Welland River	nil	3.60	cooling processing
Cyanamid of Canada Ltd. (Niagara Falls Works)	power canal	nil	15.00	cooling
Cyanamid of Canada Ltd. (Welland Works)	Welland River	nil floc. and settling	20.00	processing cooling
T.G. Bright and Co. Ltd.	drilled well	nil	0.15	cooling

The quality of the supplies is indicated by the following analyses.

Characteristics	1	2	3	4
Hardness as $CaCO_3$	128	136	126	814
Alkalinity as $CaCO_3$	100	100	88	218
Iron as Fe	0.17	0.31	1.31	0.98
Chloride as Cl	29	29	26	180
Apparent Colour Units	<5	<5	85	
Turbidity Units	1.4	1.8	2.4	
Phenols in ppb	4	0	0	
pH at Lab	8.1	8.2	8.2	7.9
M.F. Coliform Count	18,100	2,300	7,100	

1 - The Canadian Carborundum Co. Ltd.
2 - Cyanamid of Canada Ltd. (Niagara Falls Works)
3 - Cyanamid of Canada Ltd. (Welland Works)
4 - T.G. Bright and Co. Ltd.

3. Potential Additional Supplies

(a) Ground Water

Ground-water conditions are favourable in the rural areas of the city for the development of additional supplies of water for domestic and small municipal needs. Limestones and dolomites of the Lockport and Guelph formations underlie the area and are good sources of fresh water. Mineral water occurs only occasionally. The only significant overburden aquifer occurs along the northern edge of the city and is being developed by the adjacent Township of Niagara.

(b) Surface Water

The Niagara River provides a sufficient supply of water for municipal purposes to meet all future needs. A continual monitoring of the raw water quality should be carried out to indicate any additional treatment required to provide a satisfactory finished water quality.

4. Future Requirements

The maximum daily pumpages are approaching the design capacity of the filtration plant. If the population growth of Niagara Falls water area continues at its present rate the 1980 population will be close to 100,000 persons and the average daily demand may approximate 14.0 mgd. Consequently, the maximum daily pumpage will exceed the filtration capacity. It is estimated that extension of the present works will be necessary within ten years. Provision of increased storage facilities could considerably increase the ability of the present system to meet peak needs.

If phenol concentrations increase and frequently cause taste and odour problems, consideration could be given to super-chlorination or chlorine dioxide treatment.

Replacement of all mains less than six inches in diameter should be continued and all dead-ends should be eliminated by looping the distribution network.

During 1963, HEPC will be repairing sections of the power canal. As a result the Welland River will take its natural course. To protect the Niagara Falls water supply Niagara River water will be pumped into the Niagara Falls intake.

III WATER POLLUTION

1. Sewage Disposal

The developed areas of Niagara Falls are almost 100 per cent sewered with a combined sewer system. During 1962-63, projects were completed to intercept wastes discharging to the power canal and the Niagara River. The sewered areas and significant features of the sewerage works are shown in Figure 4-1.

Wastes, previously discharging to the Niagara River, are now collected at the Bender Hill, Seneca Street, and Park Street lift stations, and are pumped to the

Niagara interceptor sewer terminating at the Central Pumping Station. The Muddy Run combined sewer has been blocked and diverted to this station. Another pumping station at the former discharge point of the Muddy Run sewer pumps wastes directly to the Central Pumping Station. The total flow is then pumped through a 36-inch diameter forcemain to the sewage treatment plant. Each pumping station is equipped with a storm overflow.

Eight settling tanks, serving what was formerly Township of Stamford, previously discharged to the power canal. All the wastes collected at these tanks are now pumped or flow by gravity to the sewage treatment plant. The Brookfield tank is connected by a gravity sewer to the Muddy Run sewer. A pumping station at the Royal Manor tank raises sewage to a short gravity sewer terminating at the Dorchester Road tank. The Dorchester Road pumping station discharges to the Stamford interceptor sewer which terminates at the treatment plant. This sewer parallels the north-west side of the canal and picks up sewage from the Drummond Road tank and pumping station and receives gravity flow from the George Street, Fraser Street, and Lionite settling tanks. The Stamford Green settling tank discharges by gravity directly to the treatment plant.

A 4,570-acre area south of Lundy's Lane and Main Street and east of the power canal is served by two settling tanks. The Stanley Road sedimentation basin overflows to the Welland River and the McLeod Road settling tank discharges to the power canal.

The Niagara Falls-Stamford Sewage Treatment Plant provides coarse screening, aerated grit removal, primary settling, effluent chlorination, sludge digestion, and sludge vacuum filtration. The capacity is 10.0 mgd, sufficient to provide primary treatment for a population of 55,000. The effluent is discharged to the power canal.

Only one eight-hour composite sample has been obtained to date since the plant commenced operation in November, 1963.

	5-Day BOD	Suspended Solids
Raw Sewage	170	198
Final Effluent	100	110
Efficiency % Removal	41%	44.5%

The BOD removal is good, however, the suspended solids removal should approximate 60 per cent.

The average flow to the treatment plant during 1963, was 3.38 mgd and the maximum flow experienced was 3.588 mgd. Greater flows can be expected during the spring runoff period.

Past sampling of the effluents from the two settling tanks has indicated the following results.

Tank	No. of Samples	5-Day BOD Avg.	Min.	Max.	Suspended Solids Avg.	Min.	Max.
McLeod Road	8	113	20	191	143	84	332
Stanley Ave.	2	26	9.2	43	30	17	44

Samples were taken in March, 1964 from the municipal settling tank effluents and the raw sewage entering the sewage treatment plant to determine the heavy iron and the toxic chemical concentrations contributed by industrial wastes.

The results of the analyses follow:

Characteristics	Sewage Treatment Plant	McLeod Road Tank	Stanley Street Tank
Iron as Fe	4.8	3.0	0.8
Copper as Cu	0.2	0.0	0.01
Nickel as Ni	0.0	0.0	--
Chrome as Cr	0.01	0.0	0.0
Zinc as Zn	0.0	--	0.0
Lead as Pb	0.2	--	--
Silver as Ag	<0.1	--	--
Cyanide as HCN	0.4	0.0	0.0
Phenols in ppb	20	--	--

High concentrations of cyanide and phenols were noted at the sewage treatment plant. As these results are based on a single sampling the probability that these materials may exceed the indicated values warrants further study.

Sanitary wastes are discharged to the Niagara River from the following Niagara Parks Commission buildings: The Refectory Restaurant, Table Rock House, Queen Victoria Park lavatories, park greenhouses and repair depot, the administrative building, the Glen Restaurant, and the horticultural school. Inadequately treated domestic wastes overflow to the Niagara River from the Canadian Niagara Power Company generating station, maintenance shop and transformer station; the Ontario Power Plant; the Toronto

Power Transformer Station and main stores, and the HEPC administration building and stores. The power canal receives chlorinated septic tank effluent from the two Sir Adam Beck generating stations, the pump generating station, the reception centre, and the HEPC Conference and Development centre. Sewer connections should be provided where possible or adequate individual disposal systems should be installed.

While repairs are in progress on the power canal, the effluent from the sewage treatment plant will be directed to the power tunnel canal above the generating stations.

2. Refuse Disposal

Refuse collected from the city is disposed of by sanitary landfill between the excavated rock from the power canal, deposited north of McLeod Road and west of Montrose Road. A sample taken from the drainage ditch flowing through the landfill site indicated the presence of some pollution.

3. Industrial Waste Disposal

Industrial wastes mixed with sanitary sewage are discharged from Cyanamid of Canada Limited (Niagara Falls Works) to the power canal, and to the Niagara River via an open ditch.

Chateau Gai Wines Limited discharge process wastes high in BOD and solids to an open ditch draining to the open-cut section of the twin power tunnels. Municipal officials are presently negotiating a sewer connection.

Cyanamid of Canada Limited (Welland Works) discharges considerable quantities of process wastes through four sewers to Thompson's Creek and through four other sewers to the Welland River. Considerable quantities of solids, phenols, iron and ammonia are contained in the discharges.

Wastes which would interfere with secondary sewage treatment are discharged to the municipal sewer system from industries within the city. Organic wastes with a high BOD and solids content are discharged from a number of food processors and a winery. Toxic, heavy metal wastes, i.e. chrome, nickel, copper and silver, resulting from plating are present in the flow reaching the treatment plant. Cyanides and heavy metals from the plating processes could create problems in the receiving stream. In addition, there are galvanizing operations which produce wastes with high zinc concentrations.

4. Surface Water Quality

The results of stream samples are summarized in Table 4-1.

Generally the water quality of the Chippawa-Queenston Power Canal has been satisfactory according to the sanitary chemical and bacteriological examinations. High coliform counts were prevalent in the canal at Whirlpool Road. The phenol and iron concentrations were indicative of industrial pollution. The Welland River contained excessive coliform counts downstream from Chippawa and the Stanley Road settling tank effluent. In addition, the coliform counts in the Welland River flowing from the west exceeded 2,400 organisms per 100 ml.

Phenol and iron concentrations in the Welland River immediately west of the power canal were higher than the recommended limits of 2 ppb and 0.3 ppm respectively. These were attributed to upstream industrial waste discharges. The chemical analyses performed on samples from the Ford Motor Company water works west of the power canal have shown frequent high, BOD, iron, phenol and free ammonia contents and excessive turbidities and colour.

Thompson's Creek which is tributary to the Welland River west of the power canal exhibits extremely degraded conditions downstream from the industrial waste outfalls of Cyanamid of Canada Limited (Welland Works). Excessive BOD, coliform, iron, and phenol concentrations were found.

The quality of the Niagara River water upstream from Niagara Falls is demonstrated in Table 3-7 and by the raw water determinations performed on samples from the water filtration plant. The phenol content, coliform densities and iron concentrations fluctuate, at times exceeding OWRC objectives.

5. Future Requirements

A report prepared by H. G. Acres and Company Limited, Consulting Engineers in 1961, outlined a programme for sewage works. The plant was designed to accept the wastes from all of Niagara Falls including connection of the McLeod Road tank by 1970, and connection of the Stanley Road basin by 1975. Accordingly, the report suggested that the sewage treatment plant would require expansion to 23.0 mgd by 1975.

Alternately, considering development of Niagara Falls southward, it was suggested that a south-end treatment plant might be more feasible.

Ultimately, the population of the city has been estimated by the consultants at 250,000 persons. Considering the sewage flow from this population, the dilution ratio available in the power canal would be in the order of 200:1. Primary treatment would probably be satisfactory for many years. However, continual surveillance of water quality will indicate when secondary treatment is necessary.

IV CONCLUSIONS

The municipal water works provides an adequate supply of water of satisfactory chemical and bacteriological quality to meet the present needs of the City of Niagara Falls. However, the maximum daily pumpage is approaching the design filtration capacity. Enlargement of the filtration facilities will be required shortly. The distribution storage on the system is inadequate and should be enlarged to meet fire requirements, and peak demands. Replacement of small diameter mains should be continued.

Provision of a primary sewage treatment plant has reduced the pollution load added to the Niagara River. However, connection of the remainder of the sewered areas of the city to the plant should be implemented.

A sewer use by-law should also be enacted and enforced to prevent the discharge of toxic wastes and wastes harmful to the sewerage system, treatment process and stream life.

Pollution abatement programmes are required where industrial wastes adversely effect the quality of surface watercourses. This would apply to Cyanamid of Canada Limited (Welland Works) and Chateau Gai Wines Limited.

TABLE 4-1

SAMPLE RESULTS - CITY OF NIAGARA FALLS

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenol (ppm)	Iron as Fe (ppm)
P 2.8	Chippawa Power Canal at Whirlpool Road	June/59	6.6	186	20	4.0	1,200		
		Feb /61	2.3	184	-	2.0	114		
		June/62	1.2	214	-	1.5	23,000		
		May /63	3.1	218	-	5.0	6,000		
		Mar /64	2.7			5.0	3,800	0	0.36
P 3.6	Chippawa Power Canal at Stamford Centre Road	June/59	3.6	182	12	6.5	900		
		Feb /61	1.5	190	-	1.0	124		
		May /63	2.7	218		4.5	940		
		Mar /64	2.3			5.0	700	2	0.36
P 4.3	Chippawa Power Canal at Portage Road Bridge	June/59	1.1	168	8	6.0	800		
		Feb /61	2.7	182		1.0	79		
		May /63	2.5	214		4.0	1,100		
		Mar /64	2.2			3.5	980	2	0.36
P 5.4	Chippawa Power Canal at Dorchester St. (Traffic Circle)	June/59	6.8	166	20	3.5	700		
		Feb /61	2.4	186		1.0	63		
		May /63	3.0	216		6.0	320		
		Mar /64	2.9			4.0	1,200	0	0.36

TABLE 4-1 - Cont'd

SAMPLE RESULTS - CITY OF NIAGARA FALLS

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenol (ppm)	Iron as Fe (ppm)
P 7.2	Chippawa Power Canal at McLeod Road	June/59	0.9	172	4	4.3	300		
		Feb /61	1.7	190		2.0	47		
		May /63	2.3	210		9.0	1,150		
		Mar /64	2.5			4.5	1,900	3	0.36
P 8.8	Chippawa Power Canal at junction Welland R. at M.C.R.	June/59	0.8	180	4	3.7	500		
		Feb /61	2.5	182		1.0	84		
		June/62	1.4	228		1.7	15,000		
		May /63	3.1	196		4.0	980		
		Mar /64	2.3			4.0	1,400	3	0.30
PWE 12.1	Welland R. east opposite Sodom Road west end of Chippawa	June/59	1.2	214	6	3	500		
		Feb /61	1.5	154		3	3		
		June/62	1.0	208		1.5	5,100		
		May /63	2.4	144		5.0	290		
		Sept/63	1.2	190	2		800		
PWE 12.8	Welland R. east at bridge above mouth of Niagara River	June/59	1.5	198	44	7	1,000		
		Feb /61	2.8	178		1	45		
		June/62	1.1	194		1.3	600		
		May /63	2.5	136		4.0	200		
		Sept/63	1.2	188	2		3,800		
		Mar /64	2.2			3.6	46	3	0.45

TABLE 4-1 - Cont'd

SAMPLE RESULTS - CITY OF NIAGARA FALLS

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenol (ppb)	Iron as Fe (ppm)
PW 9.2	Welland R. west	June/59	2.8	190	4	16	300		
	at Crowland -	Feb /61	4.2	220		5	5,000		
	Willoughby line	June/62	2.2	196		1.7	14,100	2.0	
		May /63	2.6	200		5.5	730		
		Sept/63	1.2	188	2		3,800		
PWT 9.8	Thompson's Cr. at	June/59	1.6	336	50	26	66		
	Port Robinson Rd.	Feb /61	9.0	608	406		30		
	just above junction	June/62	21.0	594	53		239,000		
		May /63	2.0	1566	300	525	11,000	10	
		Sept/63	19.0	1640	220		<100,000	0	
PWT 10.8	Thompson's Cr.	June/59	12.0	302	168		20		
	just below	June/62	205	824	195		24,000,000		
	Cyanamid Plant	May /63	2.4	2080	300		90	12	18
		Sept/63	28	730	106		2,300	0	
PW 11.7	Welland R. west	June/59	2.8	200	10	12	300		
	opposite side road	Feb /61	3.7	198		2	500		
	2 3/4 miles west	June/62	2.8	292	4.5		8,000		
	of power canal	May /63	2.0	1242		250	<10	6	3.0
		Sept/63	4.6	246	27		5,000		

TABLE 4-1 - Cont'd

SAMPLE RESULTS - CITY OF NIAGARA FALLS

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Total Solids (ppm)	Suspended Solids (ppm)	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenol (ppb)	Iron as Fe (ppm)
PWE 11.1	Welland R. east opposite golf course west of Stanley Road	June/59	0.9	186	6	8.1	130		
		Feb /61	3.8	184		3.0	13,800		
		June/62	1.6	240		3.8	24,300		
		May /63	2.9	196		7.0	42,000		
		Sept/63	2.2	198	11		41,000		
PWE 11.4	Welland R. east of Stanley Road	Feb /61	2.6	198		2.0	58		
		June/62	0.6	220		1.3	3,800		
		May /63	2.2	180		6.5	270		
		Sept/63	1.6	186	2		1,300		
P 7.5D	Watercourse at McLeod Road below city dump	Mar /64	4.8	438	26	--	14,000	0	1.04
PN 1.9DS	Ditch at Stanley Street	Mar /64	60	472	100		7,100	8.0	

Note: a trace of ether solubles was determined in the sample from the ditch at Stanley Road PN 1.9 DS

CHAPTER 5

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CHAPTER 5

CITY OF WELLAND

I GENERAL

The City of Welland is located near the centre of the county astride the Welland River and the Welland Ship Canal. Drainage is mainly to the Welland River either directly or via its tributaries, Draper's Creek, Coyle Creek, Lyon's Creek, Grassy Creek and the Brown tap drain. A small portion of the northern section is drained to the Welland Ship Canal.

The 1963 assessed population is 36,712. The city is one of the most important industrial centres in the Niagara Peninsula. Plants processing steel, chemicals, and textiles, and related industries manufacturing a wide variety of goods are located within the municipality.

II WATER SUPPLIES

1. Municipal

(a) Sources

The Welland Board of Water Commissioners administers a water works system drawing water from the ship canal. Withdrawal of water is authorized by an agreement with the St. Lawrence Seaway Authority which leases up to 10 cfs for domestic purposes and a maximum draft of 250 cfs for the operation of water driven turbine pumps.

(b) Treatment Works

Complete water treatment is provided at the municipal filtration plant including, coarse screening, pre-chlorination, coagulation, settling, rapid-sand filtration, post-chlorination and fluoridation. Liquid alum is applied for coagulation. Ammonia is added to provide a chloramine residual. Hydrofluosilicic acid is injected to provide a 1.0 ppm fluoride concentration.

Standby facilities for the production and application of chlorine dioxide are available for taste and odour control.

The filtration capacity is 12.0 mgd and the low and high lift pumping capacities are 14.0 mgd and 15.0 mgd respectively.

The intake sluiceway, coarse screens, pre-chlorination and ammoniation facilities are common. However, there are two separate plants consisting of coagulation, settling, and filtration facilities. From both filtration sections the water discharges to a common clear water well and subsequently is pumped to the system.

A 1,200 gpm, water operated, turbine high lift pump utilizes water diverted from the Welland Ship Canal to the Welland River. Formerly, two of these pumps were employed requiring a diversion of 250 cfs. At present, one unit has been removed and only 150 cfs are utilized. The remaining turbine pump will be removed from service in June, 1964.

(c) Water Consumption

The average daily pumpage during 1963 was 5.64 mgd and the maximum daily pumpage was 11.005 mgd. The average daily pumpage varied from 4.92 mgd in May to 7.81 mgd in July. On peak days the consumption approaches the design capacity of the plant. The average daily per capita consumption was 144 gpcpd.

(d) Water Quality

According to the 12 bacteriological samples submitted from the treatment plant during 1963, the treated water quality was satisfactory. Of the 12 raw water samples examined, 11 contained coliform organisms varying from ten to 3,700 coliforms per 100 ml. A more intense treated water bacteriological quality monitoring programme is required. One sample per month per thousand population should be obtained from the distribution system.

The chemical quality of the raw and treated water is indicated by the results of analyses performed on samples submitted to the OWRC Laboratory during 1963.

Characteristics	No. of	Raw Water			Treated Water		
	Samples	Avg.	Min.	Max.	Avg.	Min.	Max.
Hardness as $CaCO_3$	11	130	124	140	131	120	136
Alkalinity as $CaCO_3$	11	101	96	104	96	90	102
Iron as Fe	11	0.30	0.10	0.44	0.11	0.05	0.25
Chloride as Cl	11	24	22	27	25	23	27
pH at Lab	11	8.2	8.0	8.5	7.9	7.8	8.5
Fluoride as F	11	0.1	0.0	0.2	0.79	0.0	1.3
Turbidity Silica Units	11	4.9	1.8	23.0	0.62	0.2	1.1
Free Ammonia as N	7	0.13	0.05	0.19	0.18	0.06	0.29
Silica	2	2.4	--	4.8	3.4	1.2	5.6

The treated water is moderately hard but according to the analyses performed the chemical quality is excellent for domestic consumption. The raw water iron content and turbidity fluctuate but treatment is successful in reducing these concentrations below the recommended limits. The free ammonia concentration indicates a high organic content in the raw water. The raw water contains a low natural fluoride concentration. Since August, 1963 the fluoridation process has been successfully controlled to produce the desired 1.0 ppm concentration. Phenolic compounds are frequently present. Production of chlorophenolic tastes and odours is effectively controlled at low concentrations by chlorine-ammonia treatment, and at high concentrations chlorine dioxide application prevents their development.

(e) Distribution

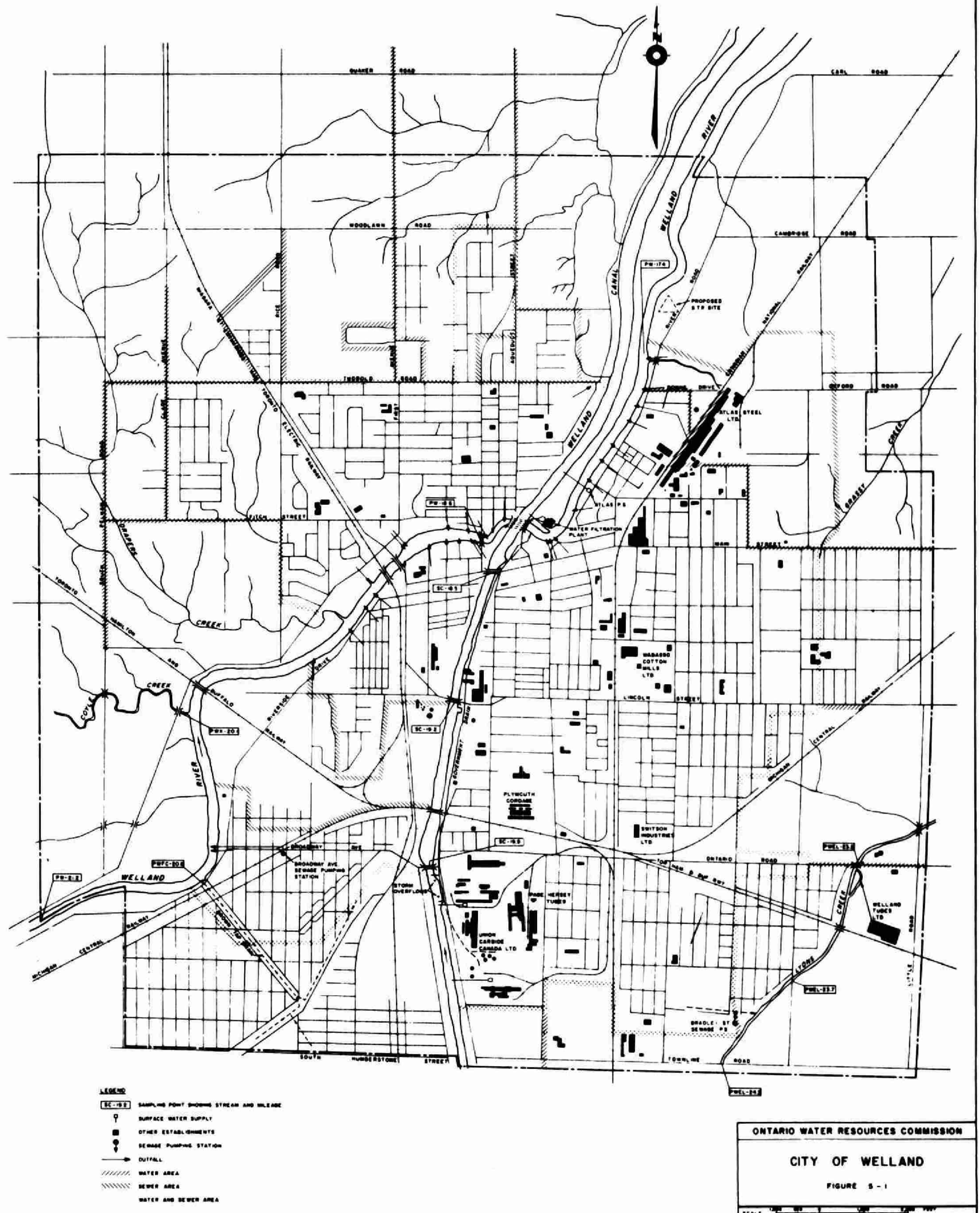
The areas served by the Welland distribution system are outlined in Figure 5-1.

Nearly all the developed area within the city boundaries is served by the municipal water works system. Portions of Crowland, Humberstone, Pelham and Thorold townships are also serviced. In the City of Welland there are 91.17 miles of cast iron, asbestos cement, and concrete pressure pipe mains varying in size from four to 24 inches in diameter.

There are 11,023 flat rate services, 126 commercial services and 49 metered industrial consumers in the city. The number of services in the adjacent townships are given in the following.

Township	Domestic	Commercial	Industrial	Approx. Pop. Served
Crowland	104	3		354
Humberstone	320	4	1	1088
Pelham	122	2		415
Thorold	191	5		649

The total capacity of the clear water storage provided at the filtration plant, including the storage in the high lift pump-wells and beneath the filters is 2.08 million gallons. A 500,000 gallon storage reservoir adjacent to Fonthill serves homes in the Township of Thorold and is fed by a booster pumping station at Thorold Road and First Avenue North. The Township of Pelham reservoir which has a capacity of 65,000 gallons is located beside the Township of Thorold reservoir.



ONTARIO WATER RESOURCES COMMISSION

CITY OF WELLAND

FIGURE 5 - 1

SCALE [illegible] FEET	
DRAWN BY A.R.S.	DATE JUNE, 1964
CHECKED BY	DRAWING No. 64-30

It is estimated that a total population of approximately 39,000 persons is served by the distribution network.

2. Private Supplies

Three industries have private water supplies drawing water from the ship canal. A brief summary of these supplies follows:

Industry	Source	Treatment	Pumpage mgd	Use
Atlas Steel Ltd.	Welland S.C.	Nil	10.0	30% processing 70% cooling
Union Carbide Canada Ltd. Metals and Carbon Division	"	Nil	2.33	cooling
Page Hershey Tubes Limited	"	97% Nil 2-3% filtered	2.1	90% cooling 10% processing

The raw water quality of these supplies is shown by the following analyses collected in March, 1964.

Characteristics	Atlas Steel Limited	Union Carbide	Page Hershey
Hardness as $CaCO_3$	138	130	132
Alkalinity as $CaCO_3$	100	100	100
Iron as Fe	0.11	0.23	0.18
Chloride as Cl	28	30	30
pH at Lab	8.4	8.3	8.5
Apparent Colour Units	<5	<5	<5
Turbidity Units	1.3	1.8	1.7
M.F. Coliforms	62	60	58

3. Potential Additional Supplies

(a) Ground Water

Ground-water conditions do not appear to be favourable in or near the city for the development of municipal supplies from ground-water sources.

(b) Surface Water

The Welland Ship Canal should provide a sufficient quantity of water of suitable chemical and bacteriological quality after treatment to meet the domestic needs of the City of Welland.

Withdrawal of large amounts of water for industrial purposes requires separate agreements with the St. Lawrence Seaway Authority.

4. Future Requirements

It has been estimated that by 1980, the population of the city will be approximately 55,000 persons if growth continues at its present rate. The population of the area served by the Board of Water Commissioners will probably approach 60,000 persons by 1980. As a result, the average daily water demand is estimated to be 9.0 mgd. The present treatment works are of sufficient size to meet this average daily demand. However, the peak demands will exceed the design capacity of the filters. Increased filtration capacity will be required.

Provision of increased storage facilities would be useful in meeting these peak demands. Previously, consulting engineers have indicated that an elevated storage reservoir with a capacity of 1.25 million gallons should be constructed in the southern section of the city. This storage would provide an emergency reserve and would also improve distribution pressures in the urban and industrial areas. Associated feeder mains are presently being installed. The construction of the elevated tank is scheduled for 1964-65.

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

Combined and sanitary sewers serve most of the developed areas discharging raw sewage, industrial wastes, and storm runoff through approximately 35 outfalls to the Welland River, the Welland Ship Canal, and Lyon's Creek. The majority of these are submerged and empty into the Welland River. Only two areas are served with completely separate storm and sanitary sewers. The sewered area is outlined in Figure 5-1. Two sewage lift stations, the Broadway Street, and the Bradley Street Pumping Station serve the two areas with separate systems. These stations discharge to the Welland River and Lyon's Creek respectively. A large portion of the city on the east bank of the ship canal is tributary to the Government Drain which parallels the canal and terminates at the Welland River. Relief sewers from the drain overflow to the ship canal above the water intake. With the exception of a small subdivision between Carleton and Aqueduct Streets the portion of the city north of Thorold Road is served with private septic tank systems. It has been reported that surface ditches in this area contain contaminating materials from malfunctioning or inoperative private systems. Sanitary sewage from the Carleton-Aqueduct area discharges to a tributary of the ship canal.

(b) Proposed Sewage Works

A report by R. V. Anderson and Associates Limited, entitled "Report on Sewage and Drainage Works in the City of Welland", was submitted to the city council in 1963. It outlined a staged programme for intercepting all the wastes presently discharged to surface watercourses. It recommended that authorization be given immediately for the design of a primary treatment plant with a capacity of 8.0 mgd to be located in the north-eastern corner of the municipality between the river road and the Welland River. The plans would permit the connection of approximately 75 per cent of the city to the treatment works by 1968 at which time the flow was estimated at 6.0 mgd. Secondary treatment facilities with a capacity of 8.0 mgd would be provided between 1968 and 1975. The report also included provisions for more adequate storm sewers throughout the city and provided a guide for the continuation of sewerage projects for a 40-year design period. The gradual separation of most of the sewer system was advised.

In addition the report indicated that the sewage from the Bradley Street pumping station constituted almost the total flow in Lyon's Creek during the summer. This separate system should be made tributary to the Welland River as soon as possible.

As a first step in following these proposals the City of Welland has called tenders for the construction of the combined east bank interceptor which will relieve the overloaded Government Drain.

2. Refuse Disposal

Refuse collected within the City of Welland is taken to a sanitary landfill site adjacent to the disused feeder canal. No pollution problems are anticipated.

3. Industrial Wastes

Almost without exception the industrial wastes are discharged to the municipal sewer system. Large volumes of cooling water and process wastes are discharged from Atlas Steels Limited, General Tire Company Limited, (Stokes Division), Canada Foundries and Forgings Limited, Switson Industries, Wabasso Cotton Company Limited, Welland Electric, Page Hershey Tubes Limited, Union Carbide Canada Limited, and Welland Tubes Limited. Separation of cooling water and contaminated process wastes is desirable to reduce the loading on any treatment facilities employed. According to the R. V. Anderson report, wastes from Switson Industries Limited, Wabasso Cotton Company Limited and Welland Tubes Limited, require pre-treatment.

The three meat packers and slaughterhouses, Niagara Sausage Company Limited, Orlando Abbatoir, and Welland Packers Limited, have satisfactory tile bed disposal systems. The Vineland Canning Company Limited spray irrigates their wastes.

The actual extent of the industrial wastes loading on the sewer system is beyond the scope of this report and will be treated in Part II.

By examination of past sampling, it has been determined that large quantities of BOD, suspended solids, phenolic compounds, and toxic heavy metals are discharged to the river and creek from industrial operations.

4. Surface Water Quality

The results of samples obtained from the river, the ship canal and the various streams tributary to the former are summarized in Table 5-1.

In past years, the OWRC has made several sampling surveys of the outfalls from the combined sewer system. The results are not included for the sake of brevity. However, the effluents during 1961 indicated excessive BOD and coliform counts. The BOD concentrations varied from 10 ppm to as high as 220 ppm and the coliform densities ranged from 85,000 to 275,000,000 organisms per 100 ml. These discharges of domestic and industrial wastes are reflected in the excessive BOD's and coliform counts in the Welland River in its passage through the city. Extremely degraded conditions are evident in Lyon's Creek downstream from the Bradley Street pumping station. High phenol and iron contents were determined at Ontario Road indicative of pollution from industrial wastes.

5. Future Requirements

Collection and treatment of all sanitary and industrial wastes discharging to surface waters in the city is imperative. Treatment of a secondary nature is required, to protect the Welland River which experiences extreme low flows in the summer. However, as the necessary sewerage works will require a large capital outlay in a staged programme with primary treatment as the first step is proposed for construction during 1965.

The discharge of wastes to Lyon's Creek should be curtailed.

Diversion of a minimum of 250 cfs from the Welland Ship Canal should be continued to provide sufficient dilution water. This will prevent the development of nuisance conditions initially, and will be necessary to aid in the assimilation of treated effluent when the treatment works are operational.

As indicated in the consultants report the new facilities should be protected from overloading by a comprehensive industrial wastes by-law.

IV CONCLUSIONS

The water filtration plant at the present time is well operated and produces a sufficient quantity of suitable quality water to meet the needs of the water area. However, increased filtration capacity will be required in the near future. Elevated storage is also required to improve pressures in the system and meet peak demands.

The discharge of domestic and industrial wastes from the City of Welland is polluting the Welland River. Collection and treatment of all wastes is required. In order to protect the Welland River, secondary sewage treatment is necessary. The first stage, the installation of the 8.0 mgd primary plant should be installed during 1965.

It is of the utmost importance that the diversion of at least 250 cfs to the Welland River from the Welland Ship Canal be continued. This increased flow is required to provide adequate dilution water and to protect the quality of downstream water supplies.

In the meantime, the discharge of untreated wastes from the Bradley Street pumping station to Lyon's Creek should be discontinued, and the sewage should be redirected through the city's sewers to the Welland River.

Improved storm sewer works are required to accept storm water which will be separated eventually where feasible from the sanitary sewers.

An industrial waste by-law should be enacted by the municipality to protect the sewer system from deterioration and to prevent interference with future treatment processes.

TABLE 5-1

SAMPLE RESULTS - CITY OF WELLAND

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Suspended	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
PW 21.2	Welland R. opposite Pelham Twp. Welland Line	June/59	14	334	64	87	50,000		
		Feb /61	5.6	264		2.0	7,700		
		June/62	2.8	300		45	39,000		
		May /63	4.4	396		65	37,000		
		Sept/63	2.6	342	54		6,000		
PWX 19.9	Coyle Cr. at bridge just above mouth	June/59	2.8	308	56		1,000		
		Feb /61	10.0	324		14	60		
		June/62	3.2	316	93		25,000		
		May /63	3.5	320		26	60,000		
		Sept/63	1.6	246	47		100,000		
PW 18.6	Welland R. west at bridge just west of ship canal	June/59	3.0	216	26	33.0	180,000		
		Feb /61	8.0	216		2.0	97,000		
		June/62	1.1	212		27.0	1,500,000		
		May /63	3.8	236		6.5	131,000		
		Sept/63	2.2	230	22		210,000		
PW 17.4	Welland R. north of Downs Road	June/59	7.1	262	74	34	3,000		
		Feb /61	4.9	182		2.0	5,800		
		June/62	2.8	240		7.0	176,000		
		May /63	6.0	260		11.0	113,000		
		Sept/63	25.0	452	220		410,000		
		Mar /64							

TABLE 5-1 - Cont'd

SAMPLE RESULTS - CITY OF WELLAND

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)		Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)	Iron as Fe (ppm)
				Total	Suspended				
PWEL 23.2	Lyon's Cr. at Ontario Road	June/59	7.6	342	8	25	190,000		
		Feb /61	21.0	398		37	5,000		11.8
		June/62	7.0	474	28		247,000	3	4.4
		May /63	2.8	588		110	16,000,000	8	35.0
		Sept/63	6.0	246	13		150,000	20	2.64

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CHAPTER 6

TOWN OF FORT ERIE

I GENERAL

The Town of Fort Erie is situated at the south-eastern tip of Welland County on the west bank of the Niagara River. The natural drainage within the town is towards Lake Erie and the Niagara River.

The 1963 assessed population is 9,114. The town supports many varied light industrial operations.

II WATER SUPPLIES

1. Municipal

(a) Sources

A municipal water works system obtains water from the Niagara River close to Lake Erie.

In case of emergency, water may also be obtained from the Bertie Township water works system which is cross-connected at five locations at the town limits; on Lakeshore Road, Dominion Road, Garrison Road, Catherine Street and Gilmore Road.

(b) Treatment

The main pumphouse, (south-end) obtains water through two gravity intakes, 20 and 10-inches in diameter extending 340 feet and 250 feet respectively from shore. Treatment consists of coarse screening, chlorination and fluoridation on the suction side of the service pumps. Sodium silico-fluoride is applied at a dosage of 1.0 ppm. The pumping capacity is 4.9 mgd and the limiting intake capacity is 10.0 mgd.

The north-end pumphouse located approximately 2 miles downstream is being renovated and equipped as a standby supply. Treatment will consist of chlorination. The rated pumping capacity will be 1.7 mgd.

(c) Water Consumption

The average daily water pumpage during 1963 was 1.44 mgd and the maximum pumpage was 2.70 mgd. The per capita consumption was 161 gpcpd. The average daily pumpage varied from 1.17 mgd in April to 2.14 mgd in July.

(d) Water Quality

During 1963, nine of 43 treated water bacteriological samples obtained from the distribution system contained coliform organisms. Twelve treated water samples from the water works were satisfactory. Three of the six raw water samples contained coliform organisms with individual counts of 44, 13 and 120 coliforms per 100 ml. A minimum of nine samples from the distribution system should be examined each month.

A summary of the results of chemical analyses performed in 1963 on samples of raw and treated water is shown below.

Characteristics	No. of Samples	Raw Water Avg.	Raw Water Min.	Raw Water Max.	Treated Water Avg.	Treated Water Min.	Treated Water Max.
Hardness as $CaCO_3$	8	129	118	138	130	120	140
Alkalinity as $CaCO_3$	8	98	86	104	97	84	106
Iron as Fe	8	0.28	0.10	0.52	0.20	0.08	0.34
Chloride as Cl	8	24	23	27	25	23	26
pH at Lab	8	8.2	7.9	8.4	8.1	8.0	8.2
Fluoride as F	5	0.16	0.0	0.3	0.78	0.6	0.9
Colour in Hazen Units	5	<7.6	<5	18	<7.1	<5	18
Turbidity	5	3.7	1.3	9.0	4.1	1.1	9.0
Free Ammonia as N	5	0.04	0.02	0.05	0.1	0.05	0.22

The raw and treated water is moderately hard, and exhibits a fluctuating iron content which at times exceeds the objective of 0.3 ppm. During storm periods the water is coloured and turbid. Daily turbidity determinations performed at the plant since May 1963 have shown an average turbidity of 7.1 ppm and a maximum turbidity of 50.3 ppm.

The raw water fluoride concentration fluctuated during 1963 but the treated water fluoride concentrations were below the optimum range of 1.0 ppm recommended to discourage dental caries.

Algal growths during the summer months have resulted in clogging of water works screens and the production of tastes and odours.

(e) Distribution

All of the developed area of Fort Erie is served by the municipal supply.

Pressure storage is supplied by two elevated storage tanks. A 250,000 gallon tank serves the northern part of town and a 333,000 gallon tank serves the southern portion.

The system contains 34 miles of mains varying in diameter from 4 to 16 inches. Low pressures are experienced in the areas served by 4-inch mains. These small diameter mains should be replaced by 6-inch mains. Numerous dead-ends exist which should be eliminated by looping the system.

There are a total of 2,983 services in the town of which 2,725 are domestic, 233 commercial and 25 industrial. There are 236 hydrants on the system.

The area served by the water works system is outlined in Figure 6-1.

2. Potential Additional Water Supplies

(a) Ground Water

Ground-water conditions do not appear to be favourable in or near the town for the development of municipal supplies from ground-water sources.

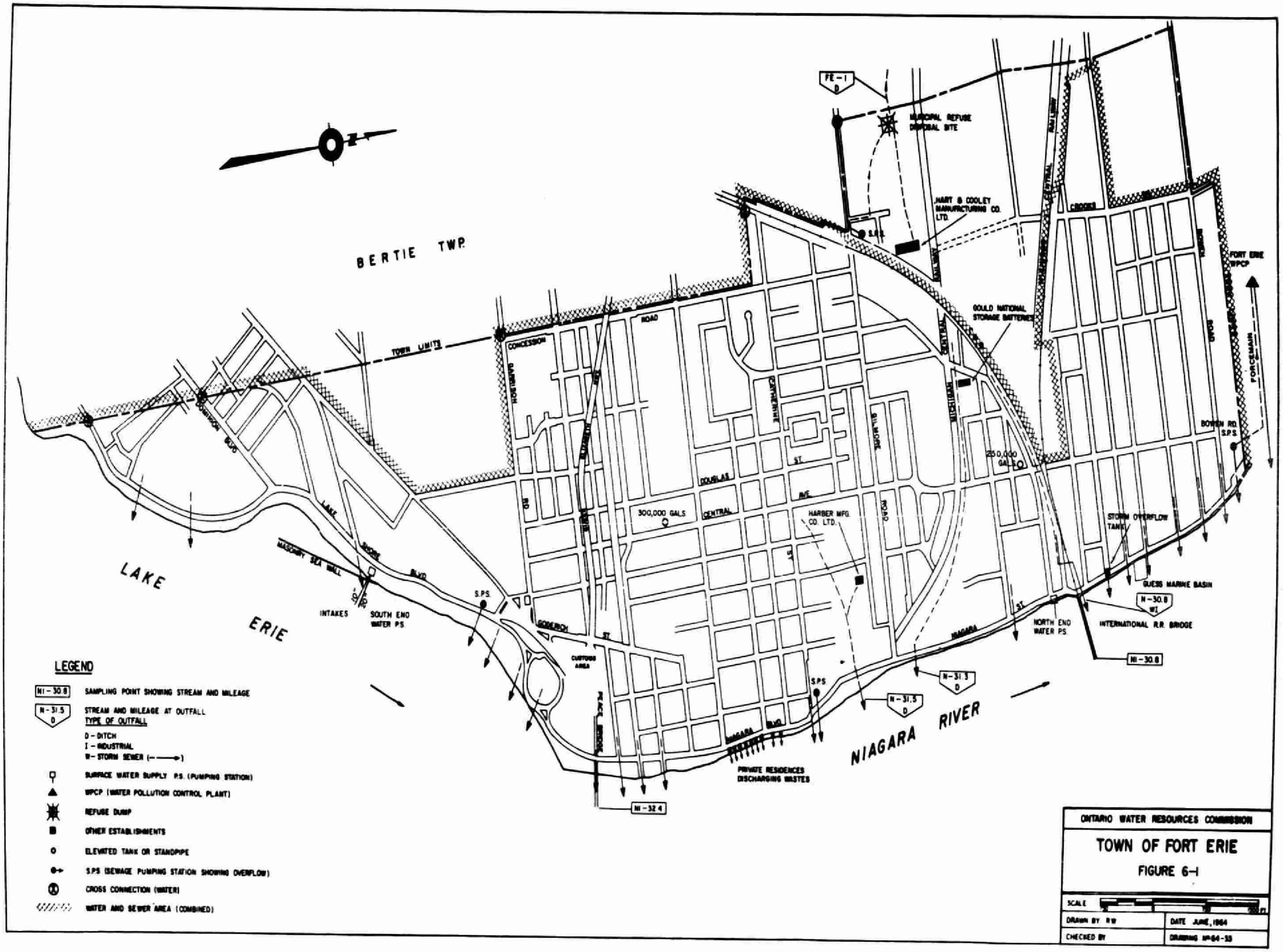
(b) Surface Water

The location of the Town of Fort Erie with respect to the Niagara River and Lake Erie provides an adequate source of surface water to meet future anticipated demands.

3. Future Requirements

Considering the past adverse physical, chemical, biological, and bacteriological quality of the treated water, more refined water treatment is required. A complete water treatment plant including, screening, coagulation, settling, filtration, chlorination, and fluoridation should be provided. Treatment processes to control tastes and odours should be considered.

The water works pumping facilities have sufficient capacity to meet the present needs of the town. If the



ONTARIO WATER RESOURCES COMMISSION

TOWN OF FORT ERIE

FIGURE 6-1

town continues to increase in population at its present rate, the 1980 population will be in the neighbourhood of 12,000 persons. An average daily demand of approximately 2.1 mgd can be expected. With increased pumping facilities this demand could readily be supplied. A complete treatment plant with a minimum capacity of 4.0 mgd should be considered.

Approximately 38 per cent of the mains are less than 6 inches in diameter resulting in low pressures and inadequate fire flows. All undersized mains should be replaced with larger diameter lines. An engineering study of the system should be implemented to improve water distribution. Where possible the lines should be looped to eliminate dead-ends.

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

Fort Erie is almost completely sewered with a system of sanitary sewers which also receive storm water from roof drains. Storm sewers are provided throughout most of the municipality discharging through 26 outlets to the Niagara River. Past sampling has indicated that domestic sewage does not reach the storm drains. Sewage works and sampling stations are shown in Figure 6-1.

Sanitary and trade wastes are collected by the Niagara Street trunk sewer which terminates at the main sewage pumping station north of Bowen Road. Three other sewage lift stations are utilized to overcome topographical limitations. The Catherine Street and Lakeshore Road pumping stations are equipped with storm overflows to the Niagara River. The Gilmore Road pumping station serving a small area in the west-end has no storm overflow. A storm overflow chamber and relief sewer is located at the junction of the Jarvis Street and Niagara Street trunk sewers, discharging flows in excess of 4.7 mgd to the Niagara River. An overflow weir at the Bowen Road pumping station discharges storm flows in excess of 5.9 mgd to the river.

Eight cottage type buildings located along Niagara Boulevard discharge sanitary wastes directly to the river. Correction of this situation is required.

Since October 7, 1963, the Fort Erie Sewage Treatment

Plant, constructed as an OWRC project, has provided primary treatment. An 18-inch diameter forcemain delivers the wastes from the Bowen Road pumping station to the plant immediately north of the town in the Township of Bertie.

The plant was constructed to treat the wastes from a design population of 12,000 persons at an average flow of 1.8 mgd and a maximum flow of 4.5 mgd.

Treatment consists of grit removal, primary settling, effluent chlorination and sludge digestion. Liquid digested sludge will be hauled to surrounding farmland for final disposal. The chlorinated effluent is discharged to the Niagara River. The efficiency of treatment is indicated by the following summary of three eight-hour composite sample results determined during 1963.

	5-Day BOD				Suspended Solids			
Item	Avg.	Min.	Max.	% Rem.	Avg.	Min.	Max.	% Rem.
Raw Sewage	82	64	108	--	66	72	62	
Final Eff.	59	36	86	28	46	49	41	33.4

The BOD removal was satisfactory; however, the plant should be capable of removing 60 per cent of the suspended solids.

Examination of the flow records at the plant revealed that the average daily flow to the plant from October 7 to December 31, 1963, was 1.66 mgd. The maximum daily flow recorded during this period was 5.6 mgd. Storm flows to the Bowen Road pumping station will greatly exceed these figures.

(b) Proposed Sewage Works

Provision was made in the design to permit extensions of the plant and increases in pumping capacity at the Bowen Road station. The plant is also laid out to permit ease in conversion to a full secondary treatment facility.

2. Refuse Disposal

Refuse is hauled to an open dump at the western edge of town between the Michigan Central and CN rights-of-way. Pollution of a drainage ditch passing through the site is evidenced by a sample obtained in April 1964.

3. Industrial Waste Disposal

Four industries discharge process wastes to surface drainage ditches.

Wash water containing oils is discharged from the Canadian National-Wabash shop to a drainage ditch tributary of the Niagara River. An oil separator is installed in the ditch but oily material escapes at times.

The Gould National Storage Batteries of Canada Limited discharges acid wastes high in suspended solids to a ditch flowing to the Niagara River at the foot of Gilmore Road.

Acid, pickling wastes from Harber Manufacturing Company Limited are treated in a limestone bed and then released into a ditch emptying into the Niagara River south of Gilmore Road.

Chromic acid wastes are discharged without treatment to a ditch tributary of Frenchman Creek from Hart and Cooley Manufacturing Company of Canada Limited.

4. Surface Water Quality

The quality of the Niagara River as it passes Fort Erie is indicated by the sample results of Table 3-7, and by the raw water conditions at the water works.

Samples from the drainage ditches receiving industrial wastes are included in Table 6-2.

The coliform densities in the Niagara River are not excessive at the stations noted. Reduction in the phenol concentrations has been noted noted since sampling was commenced. Some pollution is evident in the four ditches sampled.

5. Future Requirements

The new sewage treatment plant should be capable of providing efficient primary treatment at the present time. Based on flow data the hydraulic loading is approaching the average design capacity. It is apparent from the weak characteristics of the raw sewage that considerable infiltration and storm water is admitted to the sanitary sewer system. All roof drain connections to sanitary sewers should be severed.

IV CONCLUSIONS

Complete water treatment including pre-chlorination, coagulation, sedimentation, rapid-sand filtration, and post-chlorination facilities should be provided. All the undersized mains should be replaced and the existing dead-ends should be looped into the distribution network. An engineering study to improve distribution within the system is advisable.

The new sewage treatment plant should be adequate to meet the needs of the town for some years. All private residences discharging sanitary wastes to the Niagara River should connect to the sanitary sewers or provide suitable disposal systems. All roof drain connections to the sanitary sewer system should be located and severed.

Pollution is indicated in the drainage from the refuse disposal area.

TABLE 6-2

SAMPLE RESULTS - TOWN OF FORT ERIE

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Iron as Fe (ppm)	Phenols (ppb)	Turbidity in Silica Units	pH at Lab	Alkalinity as $CaCO_3$	Chrome as Cr	Lead as pb	Ether Solubles	M.F.Coliform Count per 100 ml
Ni 34.3	Niagara R. International RR Bridge	Mar /64	2.5	0.12	0	2.1	--	--	--	--	--	8
FE 1D	Ditch to Frenchman Cr.	Mar /64 Apr /64	4.0 3100	-- 140	-- 800	--	--	94	0.4	0.0	--	780 360,000
N 31.5D	Ditch south of Gilmore Rd.	Mar /64	4.4	--	--	--	7.2	102	--	--	--	1,430
N 31.3D	Ditch north of Gilmore Rd.	Mar /64	4.6	--	--		8.0	86	--	1.0	--	180
N 30.8WI	Railway storm sewer to Niagara River	Mar /64		--	0	--	--	--	--	--	90	--

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CHAPTER 7

TOWN OF PORT COLBORNE

I GENERAL

The Town of Port Colborne is situated at the entrance to the Welland Ship Canal on Lake Erie. In general, natural drainage is toward Lake Erie. The area is flat and only the sand dunes along the lakeshore rise more than 25 feet above the water level of Lake Erie.

The 1963 assessed population is 17,043 persons. Five large industries within the town provide employment for approximately 2,700 persons while the remainder of the work force commutes to the industries in nearby municipalities.

II WATER SUPPLIES

1. Municipal

(a) Sources

A municipally owned and operated water works system draws its supply from the Welland Ship Canal, upstream from all control works and locks. The municipal system is interconnected with the International Nickel Company Limited water system which is supplied from the ship canal.

(b) Treatment Works

The water supply receives chlorination and pressure filtration. Alum is applied prior to the filters, but its effectiveness as a coagulant is limited due to the lack of adequate mixing and settling facilities. Sodium chlorite is applied with chlorine producing chlorine dioxide to oxidize phenolic compounds contained in the raw water.

Three pumps in series draw from a 25-inch diameter intake and a fourth pump draws from a 16-inch diameter intake. The rated capacity of the pumps is 6.48 mgd but the actual capacity is 5.4 to 6.0 mgd.

The capacity of the filters at two US gpm per square foot is 2.42 mgd.

(c) Consumption

During 1963, the average daily consumption was 2.25 mgd and the maximum daily pumpage was 4.40 mgd. The average daily consumption varied from 1.87 mgd in November to 3.35 mgd in July. The average daily per capita consumption was 129 gpcpd.

The consumption during the summer period exceeds the rated capacity of the filters and it is necessary that these be operated at higher than recommended filtration rates.

During 1963, lawn sprinkling restrictions were imposed to conserve water.

(d) Water Quality

Of the 24 raw water bacteriological samples examined during 1963, 22 contained coliform organisms ranging from two to 6,900 organisms per 100 ml. The total number of treated water samples examined by the OWRC during 1963 was 72 of which nine samples contained low densities of coliform organisms, varying from one to 11 coliforms per 100 ml. Generally, the bacteriological quality of the treated water was satisfactory.

A minimum of 18 distribution samples per month should be examined to monitor the water quality.

The chemical quality of the raw and treated water is shown in the following summary of the results of samples submitted during 1963.

Characteristics	No. of Samples	Raw Water Avg.	Raw Water Min.	Raw Water Max.	Treated Water Avg.	Treated Water Min.	Treated Water Max.
Hardness as $CaCO_3$	24	129	114	140	131	114	150
Alkalinity as $CaCO_3$	24	100	96	108	100	92	106
Iron as Fe	24	0.22	0.10	0.76	0.09	0.00	0.50
Chloride as Cl	24	25.2	21	31	27.4	23	31
pH at Lab	24	8.1	7.6	8.5	7.9	7.5	8.2
Fluoride as F	13	0.15	0.0	0.3	0.1	0.1	0.2
Turbidity in Silica Units	17	2.16	0.5	4.5	0.85	0.3	2.0
Free Ammonia as N	13	0.13	0.02	0.29	0.11	0.02	0.19
Phenols in ppb	6	4.3	0	18	2.0	0.0	9.0
Colour in Hazen Units	5	<5	0	<5	<5	<5	<5

The water is moderately hard and exhibits a fluctuating iron, free ammonia, and phenol content. The iron content usually is reduced by treatment below the recommended limit of 0.3 ppm. The phenol content in the raw water is usually successfully oxidized by chlorine dioxide treatment. The high free ammonia content is typical of organically rich waters. The raw water turbidity is low.

(e) Distribution

The developed areas of Port Colborne are served by the municipal distribution network. The area serviced is outlined in Figure 7-1. Portions of Humberstone are also supplied with water by Port Colborne.

The distribution system consists of approximately 42 miles of cast iron mains varying in diameter from 4 to 16 inches and five miles of steel main varying from 2 to 12 inches in diameter. The system is divided into two parts by the ship canal and the canal crossing is made by duplicate 12-inch diameter mains passing under the canal at Clarence Street.

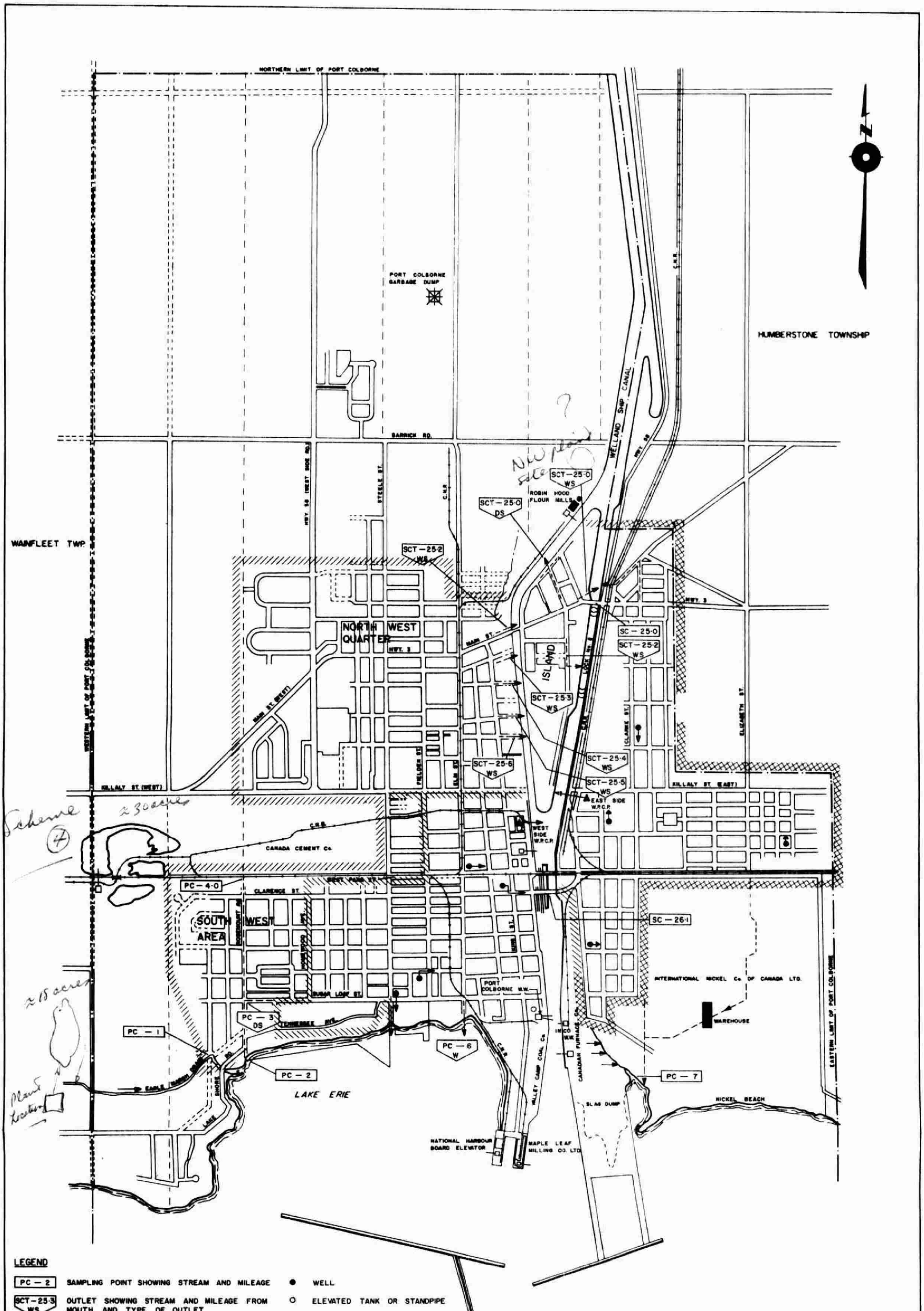
There are 4,950 services of which 86 are metered commercial and industrial services. Water is also supplied to 75 services in the Township of Humberstone.

Distribution storage consists of a 250,000 gallon elevated tank located at the filtration plant. Increased storage capacity is required to meet fire demands. Any storage facilities should be located on the eastern side of the ship canal. Low pressure problems have been experienced due to the lack of adequate sized feeder mains.

2. Private Supplies

The five major industries own and operate water supplies drawing from Lake Erie directly or indirectly via the ship canal. The private supplies are summarized below.

Industry	Source	Treatment	Pumpage mgd	Use
Algoma Steel Ltd. Canadian Furnace Division	Welland Ship Canal	batch chlor.	16.0	80% cool. 20% proc.
INCO	Welland Ship Canal	chlor. soft.	7.2	2% san. 98% cool. and proc.
Maple Leaf Milling Co. Ltd.	Lake Erie	chlor. filt.	.036	sanitary proc.



LEGEND

PC — 2	SAMPLING POINT SHOWING STREAM AND MILEAGE
SCT-25·3 WS	OUTLET SHOWING STREAM AND MILEAGE FROM MOUTH AND TYPE OF OUTLET
D	DITCH (— — — —)
S	SANITARY SEWER
W	STORM SEWER (– ——▶)
⊡	SURFACE WATER SUPPLY
▲	WATER POLLUTION CONTROL PLANT (W.P.C.P.)
✳	REFUSE DUMP
■	OTHER ESTABLISHMENTS
↓	SEWAGE PUMPING STATION
●	WELL
○	ELEVATED TANK OR STANDPIPE
——▶	PRIVATE OUTFALL
▨	WATER AREA
▧	SEWER AREA
▩	WATER AND SEWER AREA

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TOWN OF PORT COLBORNE

FIG. 7—1

SCALE: 600 0 1200 2400 FEET

DRAWN BY: H.G
DATE: APRIL 1964
CHECKED BY
DRAWING No: 64—23

Industry	Source	Treatment	Pumpage mgd	Use
National Harbours Board	Lake Erie	chlorine dioxide		sanitary cooling air cond.
Robin Hood Flour Mills	Welland Ship Canal well	filt. chlor.	.063	10% san. 70% proc. 20% cool.
Canada Cement Co. Ltd.	Welland Ship Canal quarry	nil nil		fire fighting

The quality of the water obtained from these supplies is indicated by the following samples.

Characteristics	1	2	3	4	5	6	7	8
Hardness as $CaCO_3$	132	132	136	146	134	734	322	168
Alkalinity as $CaCO_3$	100	100	96	100	96	184	160	78
Iron as Fe	0.10	0.09	0.10	0.10	0.09	0.28	0.81	0.26
Chloride as Cl	29	28	26	27	28	21	46	41
pH at Lab	8.3	8.3	8.2	7.9	8.2	7.5	7.6	8.5
Apparent Colour Units	<5	<5	<5	<5	<5	<5	10**	5**
Turbidity	1.1	1.0	2.6	1.4	1.0	1.4	3.1	5.5
M.F. Coliform	1	121	0	0	0	24	78	4

1. Algoma Steel Limited
2. INCO
3. Maple Leaf Milling Co. - chlorinated canal water
4. National Harbours Board - chlorinated infiltration well
5. Robin Hood Flour Co. - chlorinated canal water
6. Robin Hood Flour Co. - well supply
7. Canada Cement Co. - quarry supply
8. Canada Cement Co. - canal water

** Test performed on settled sample

3. Potential Additional Supplies

(a) Ground Water

Ground-water conditions do not appear to be favourable in or near the town for the development of municipal supplies from ground-water sources.

(b) Surface Water

The ship canal and Lake Erie provide satisfactory surface sources to meet the water supply needs of the town.

4. Future Requirements

At the present time, the filtration capacity is exceeded during the summer months. Improved and enlarged treatment facilities are required. Complete treatment, including coarse screening, coagulation, settling, rapid-sand filtration, and pre and post-chlorination should be provided. The present chlorinators, pumps, and chlorine dioxide generating equipment could be utilized in the treatment works.

If growth of the municipality continues at its present rate, the population of Port Colborne will approach 26,000 persons by 1980 and the average daily demand may approximate 3.8 mgd. To meet these demands a treatment plant should be constructed with a minimum capacity of 7.5 mgd. Increased intake capacity would be desirable.

To meet the present fire demand increased storage capacity is required. Elevated storage on the east side of the the ship canal should be provided.

In addition, another canal crossing could be made to feed the eastern distribution network from two points.

Replacement of small diameter mains is also required to improve fire protection and system pressure.

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

Sanitary sewers serve approximately 60 per cent of the town. The developed area on the east side of the ship canal is completely sewered. Four lift stations are utilized to direct the sanitary wastes to the east side disposal plant. On the west side of the canal, the area bounded by Killaly Street, Fielden Avenue, Park Street, Homewood Avenue, Tenessee Avenue and Sugar Loaf Street has sanitary sewers which discharge to the west side treatment plant. Four lift stations are provided. Both treatment plants are operated by the OWRC. The sanitary sewers in many areas of the town are old and as a result, infiltration is great. The remainder of the town is served by individual septic tank systems. The heavy clay, impervious soil and the limited depth to rock has resulted in malfunctioning of septic tank and tile bed systems. Consequently, in the north-west portion of the town, in the south-western corner and on the island between the Third Welland Canal and the ship canal many private systems are connected to storm sewers or discharge to open storm ditches. The main features of the sewerage system are shown in Figure 7-1.

In Table 7-1 the results of sanitary chemical and bacteriological examinations indicate the presence of domestic wastes in the storm sewers in the south-west corner and in the open ditches in the north-west quarter and on the island. Refer to Figure 7-1 for sampling point locations.

East Side Sewage Treatment Plant - This plant, a 0.5 mgd activated sludge plant, provides coarse screening, grit removal, comminution, mechanical aeration, final settling and sludge digestion. Flows reach the plant via three forcemains. Considerable by-passing occurs at the influent works prior to the flow measuring device when the larger capacity pumping stations (Clarke Street and Fretz Subdivision) are operating. As a result, the flow figures are incomplete. The hydraulic loading on the plant has actually been estimated at considerably greater than the design flow.

The treatment provided to the portion of the flow accepted by the plant is indicated by the following.

	5-Day BOD				Suspended Solids			
	Avg.	Min.	Max.	% Rem.	Avg.	Min.	Max.	% Rem.
Raw Sewage	122	57	200		128	50	234	
Final Effluent	17	4	49	86	17	7	42	87

The raw sewage is weak because of the considerable quantity of infiltration.

The surges frequently result in a loss of the activated sludge necessary for treatment.

West Side Sewage Treatment Plant - An activated sludge facility, the plant is designed to provide complete treatment for a dry weather flow of 0.90 mgd, or for the wastes from a population of 9,000 persons. Primary treatment can be provided for flows up to 3.60 mgd with higher flows by passed to the Welland Ship Canal. Treatment consists of coarse screening, grit removal, primary settling, mechanical aeration, final clarification, sludge digestion and effluent chlorination. The treated effluent is discharged to the ship canal. The average daily flow during 1963 was 0.62 mgd and the maximum daily flow was 1.49 mgd.

The efficiency of treatment is indicated by the following summary of 1963, 8-hour composite sample results.

	5-Day BOD				Suspended Solids			
	Avg.	Min.	Max.	% Rem.	Avg.	Min.	Max.	% Rem.
Raw Sewage	106	30	290		112	38	462	
Final Effluent	11.5	3.0	32	88.5	12.8	2.0	52	88.5

The treatment works are underloaded but produce a satisfactory effluent

The raw sewage pumphouse situated behind the town hall discharges raw sewage directly to the ship canal during storm flow periods.

Oakwood Road Public School - Sewage Treatment Plant

An 8,000 US gpd rated aeration, activated sludge plant serves the Oakwood Road public school. Treatment consists of aeration, final settling and effluent chlorination. The effluent is discharged to a roadside ditch which is tributary to the Eagle Marsh. Approximately 470 persons are served. Since May, 1962, six grab samples of the effluent have been obtained which showed a range in BOD from 6 ppm to 88 ppm and a suspended solids range from 10 to 64 ppm. Operation of the facility is difficult because of the fluctuating and intermittent nature of the flows. Recent inspections have indicated satisfactory operation.

(b) Proposed Sewage Works

A report prepared by Canadian-British Engineering Consultants in 1961 outlined the sewerage needs of the town. The report recommended the installation of a third treatment plant (the south-west plant) to serve the part of Port Colborne west of Homewood Avenue and south of Park Street. Initially the primary plant would serve 3,000 persons with stage expansion to a 9,000 person capacity. The effluent would overflow to the Eagle Marsh Drain a short distance from its mouth at Lake Erie. The report also concluded that the north-west area should be sewered and the flow directed to the west side disposal plant. In addition, the municipality was divided into 14 sewer areas to be served by pumping stations. The town council has requested that these proposals be implemented as OWRC projects.

2. Refuse Disposal

Refuse collected in Port Colborne is transported to an open dump within the municipal boundaries, situated north of Barrick Road and west of Elm St. The site is adjacent to the bog area in Wainfleet Township. The area drains northward to the Biederman drain which is a tributary of the Welland Ship Canal. There have been no pollution problems.

3. Industrial Waste Disposal

Alkaline wastes with high suspended solids, containing phenols are discharged from Algoma Steel Limited, Canadian Furnace Division to a small creek immediately east of the ship canal.

Processing wastes and cooling water are discharged by INCO via a storm sewer directly to Lake Erie at the mouth of the creek. Suspended solids and nickel concentrations are contained in this flow.

The Port Colborne Dairy discharges milk wastes to a septic tank which overflows into a storm sewer along Killaly Street West which in turn empties into the ship canal.

The Canada Cement Company Limited discharges process wastes containing suspended solids to a ditch draining to Lake Erie at the south end of Rosemount Street.

Wheat washing wastes, high in BOD and suspended solids are discharged to Lake Erie from the Maple Leaf Milling Company Limited and The National Harbours Board. Similar wastes are also discharged to the ship canal by Robin Hood Flour Mills Limited. Grain dust from all three establishments is released also to these surface waters.

4. Surface Water Quality

The results of samples obtained from the ship canal, Lake Erie, and the various drainage ditches and storm sewers from the areas lacking sanitary sewers are shown in Table 7-1.

Considerable amounts of contaminating materials are discharged to the ship canal from storm sewers in the north-west quarter of the town. However, the BOD in the canal has been satisfactory. Prior to the complete sewering of the east side of the canal the coliform densities in the canal at the Main Street bridge were excessive.

The drainage ditches in the south-western corner of the town contain septic tank effluent.

5. Future Requirements

The weak character of the raw sewage suggests considerable infiltration. An infiltration study of the sewer system should be carried out to determine which sewers require replacement.

The capacity of the east side plant should be increased to accept the total flow from the pumping stations without the occurrence of by-passing. Primary settling should be provided as well as effluent chlorination. Repair of the aeration tank mechanical equipment is also required. Complete sewering of the north-west quarter and the island is required.

The third plant and associated sewerage works should be provided in the south-western quarter.

IV CONCLUSIONS

Planning for future water needs should include a complete treatment plant providing pre-chlorination, coarse screening, coagulation, sedimentation, rapid-sand filtration and post-chlorination. The plant should be able to meet the maximum demand of approximately 7.5 mgd expected by 1980 and it should also be designed to allow ease in expansion as required by population growth. Increased storage is required to meet fire and peak demands. Elevated storage on the east side of town would be desirable.

The sewering of the entire east side of Port Colborne has eliminated many sources of pollution previously existing. Efforts should be continued to sewer the remainder of the developed areas, notably the north-west portion of town, the island, and the south-west area. Provision of the south-west treatment plant will eliminate pollution of local drainage ditches.

The east side sewage treatment plant requires expansion and renovation. The plant is hydraulically overloaded and by-passing compromises treatment. The provision of primary sedimentation and effluent chlorination facilities is necessary in addition to repair of the aerators.

TABLE 7-1

SAMPLE RESULTS - TOWN OF PORT COLBORNE

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	M. F. Coliform Count per 100 ml	Iron as Fe (ppm)	Phenol (ppb)	Alkalinity	pH at Lab
PC 1	Eagle Marsh Drain at Lakeshore Rd. Culvert	June/59	14	388	52	336	10,000				
D		May /61	5.6	504	132	372	10				
PC 2	Ditch outlet Rosemount Ave.	June/59	3	472	12	460	40,000				
D		May /61	14	536	10	526	27				
PC 3	Ditch Sugarload St. intersection with Rosemount Ave.	June/59	74	732	210	522	90,000				
DS		May /61	4.8	554	48	506	299				
PC 4	Drain from Canada Cement Co. Ltd. to open ditch Rosemount Ave.N.	June/59	10	470	34	436	10,000				
D		May /61	2.5	500	6	494	2,900				
PC 6	Storm sewer outlet at Elm St.	June/59	2.6	508	14	494	10,000				
W		May /61	3.6	278	14	264	27				
PC 7	Sample from mouth of small creek	June/59	5.2	258	42	216	--	4.6	13	113	8.6
I											

TABLE 7-1 - Cont'd

SAMPLE RESULTS - TOWN OF PORT COLBORNE

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Phenol (ppb)	Alkalinity	pH at Lab
PC 8 WI	Storm drain from INCO property	June 6/59		1786	180	1606	--	0.8	--	120	7.3
		June 29	9.4	920	24	896	10,000				
SC 26.1	Welland Canal at Clarence St. bridge	Aug 9/60	1.3				70				
		June12/61	0.9	186			800				
		Nov 13/62	1.7	210	2	208	70				
SCT 25.6 WS	Storm sewer outlet Union St.	June /59	113	406	36	370	33,000,000				
		May /61	28	442	24	418	49				
SCT 25.5 WS	Sewer outlet Charles St.	June /59	218	492	68	424	16,000,000				
		May /61	135	568	72	496	610,000				
SCT 25.4 WS	Storm sewer outlet George St.	June /59	258	596	86	510	14,000,000				
		May /61	48	362	20	342	79				
SCT 25.3 WS	Storm sewer Neff St. south side	June /59	68	372	42	330	5,000,000				
		May /61	96	560	52	508	7,900				
SCT 25.2 W	Storm sewer outlet Niagara St. from ditch	May /61	46	526	94	432	207,000				

TABLE 7-1 - Cont'd

SAMPLE RESULTS - TOWN OF PORT COLBORNE

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Phenol (ppb)	Alkalinity	pH at Lab
				Total	Susp.	Diss.					
SC 25.0 W	Storm sewer outlet Main St. and Ramsey Ave.	May /61	17	306	86	220	760,000				
SCT 25.2 W	Storm sewer outlet Main St.	May /61	409	354	58	296	18,400				
SC 25.0	Welland Canal at Main St. bridge	Aug 9/60	1.6				114,000				
		Jan12/61	3.6	194			108				
		June18/62	1.0	220			7,000				
		Nov13/63	1.8	224	3	221	830				
SCT 25.0 DS	Drainage ditch Mellowby Ave.	June /59	210	512	122	370	61,000,000				

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CHAPTER 8

TOWN OF THOROLD

I GENERAL

The Town of Thorold is situated on the Welland Ship Canal at the northern boundary of the county. Its northern limits abut the City of St. Catharines. The developed portion is mainly on the western side of the canal. Drainage flows almost exclusively to the former Second Welland Canal industrial waste drain which bisects the developed areas of the town. The north-east corner drains to Ten Mile Creek, a tributary of the ship canal.

The Second Welland Canal industrial waste drain enters the town as an open cut channel which changes to a box culvert at Lyndon Street. It emerges as an open channel immediately north of the boundary with St. Catharines. The St. Lawrence Seaway Authority diverts approximately 52-54 cfs from the ship canal through a control station near the highway 58 drawbridge to provide dilution for the industrial wastes.

The town is heavily industrialized with pulp and paper mills and metal processing industries.

The 1963 assessed population is 8,679.

II WATER SUPPLIES

1. Municipal

(a) Sources

The Thorold Public Utilities Commission operates a municipal water works system drawing its supply from a channel connected to the ship canal in the Township of Thorold. An agreement with the St. Lawrence Seaway Authority authorizes the withdrawal of 25 cfs. A 36-inch and a 24-inch intake are utilized.

(b) Treatment Works

The pumphouse in the township discharges water through two supply mains to the treatment plant or directly without treatment to local industries. Coarse screening is carried out at the pumping station.

Treatment at the filtration plant consists of pre-chlorination, coagulation, sedimentation, fluoridation, pressure filtration, and post-chlorination. Alum is applied for coagulation and sodium silicofluoride is added.

The low lift pumps have a capacity of 10.3 mgd. The settling tanks are designed to treat 3.0 mgd. The limiting capacity of the system is 2.3 mgd which is the capacity of the five anthrafilt filters at 2 US gpm per square foot.

The rated capacity of the high lift pumps drawing from a suction well connected to the 100,000 gallon clear water reservoir beneath the filters is 6.6 mgd. Pumps drawing from the settling tanks and delivering to the pressure filters have a rated capacity of 5.8 mgd.

(c) Water Consumption

During 1963 the average daily raw water pumpage was 6.33 mgd and the average daily treated water consumption was 1.21 mgd. The maximum daily pumpages were 9.5 mgd raw water and 2.5 mgd treated water. The untreated industrial pumpage represents 80 per cent of the total supplied.

The average daily per capita treated water consumption is 140 gpcpd.

(d) Water Quality

Nine of the 11 raw water bacteriological examinations made during 1963 indicated coliform organisms ranging from 2 to 172 organisms per 100 ml. All 11 treated water samples from the filtration plant were satisfactory. All of the 141 bacteriological samples obtained from the distribution system by the Welland County Health Unit were also satisfactory during 1963.

The chemical water quality is indicated by the following summary of samples collected during 1963.

Characteristics	No. of Samples	Raw Water Avg.	Raw Water Min.	Raw Water Max.	Treated Water Avg.	Treated Water Min.	Treated Water Max.
Hardness as $CaCO_3$	12	137	124	194	132	124	146
Alkalinity as $CaCO_3$	12	109	94	176	92	88	100
Iron as Fe	12	0.75	0.22	2.44	0.15	0.05	0.28
Chloride as Cl	12	24.7	22	32	25.5	23	31
Fluoride as F	23	0.13	0.0	0.2	1.03	0.6	1.3
pH at Lab	12	8.1	7.7	8.2	7.5	7.3	7.9
Turbidity	12	11.3	1.1	43.0	0.8	0.3	1.5
Colour in Hazen Units	1	<5	<5	<5	<5	<5	<5

The raw water hardness, alkalinity, iron content and turbidity fluctuates widely. The water is moderately hard. Treatment has been successful in reducing the iron content and turbidity to satisfactory levels. According to the treated water fluoride analyses the average fluoride concentration has been acceptable.

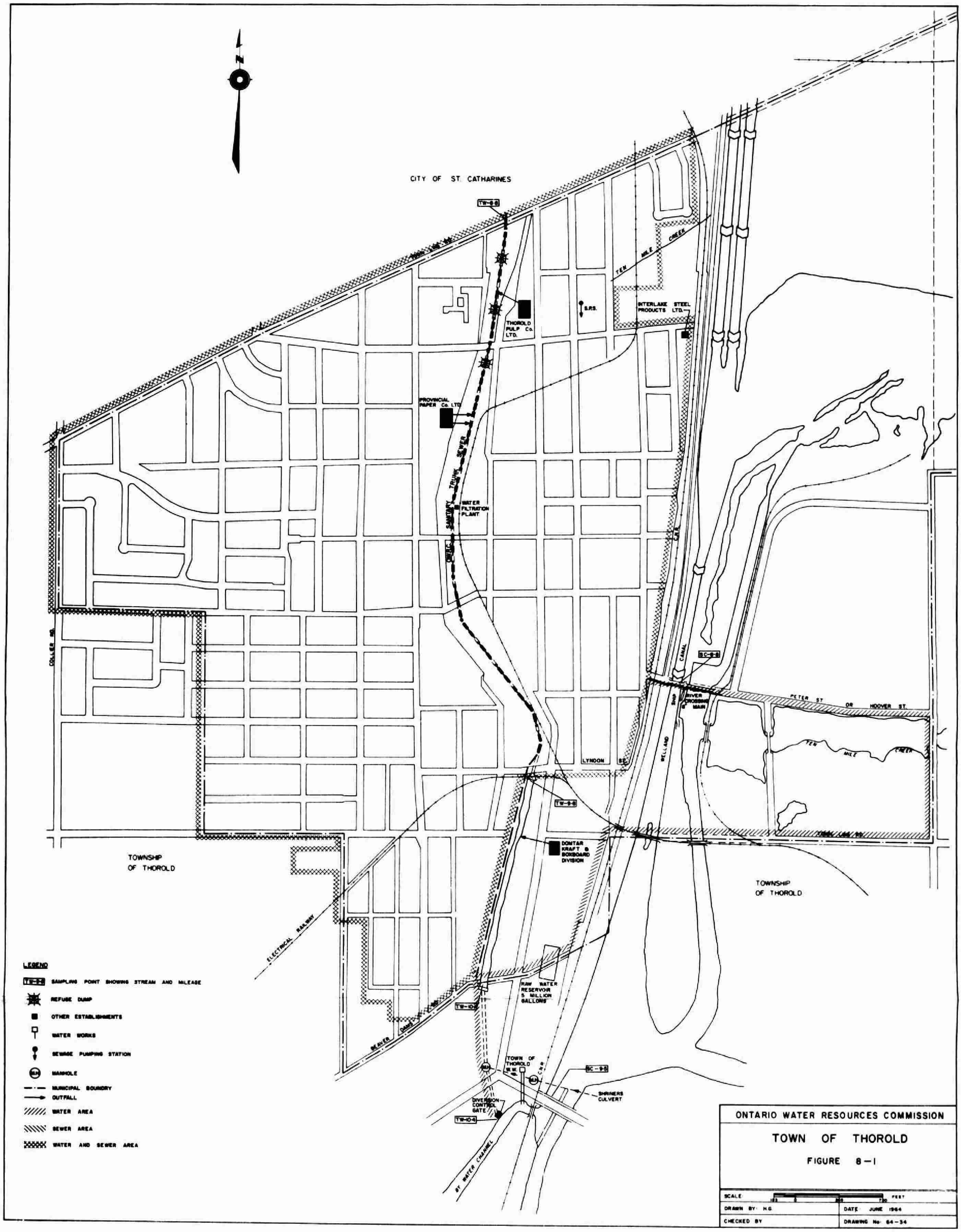
(e) Distribution

Most of the developed area within the town is served by the municipal water works system. This area is outlined in Figure 8-1. In addition approximately 1,200 persons located in the Township of Thorold are also supplied.

There are 2,251 domestic, 213 commercial and 58 industrial consumers. In the Township of Thorold, there are 13 services to the south-east of the town and approximately 236 in the Collier Road area.

There are approximately 24 miles of cast iron mains varying in size from 4 to 20 inches in diameter. Two 10-inch diameter mains cross the Second Welland Canal culvert at Albert Street to serve the western portion of town and dual 8-inch mains cross the Welland Ship Canal at Hoover Street to serve the portion to the east. Distribution is limited by the number of 4-inch diameter mains which still exist. These should be replaced with 6-inch minimum diameter mains. There are 165 hydrants spread throughout the system.

An open raw water reservoir with a 5.0 mg capacity is maintained as a standby supply. The only treated water storage is the clear water reservoir of 100,000 gallons at the filtration plant.



ONTARIO WATER RESOURCES COMMISSION

TOWN OF THOROLD

FIGURE 8-1

DRAWN BY: H.G.
DATE: JUNE 1964
CHECKED BY
DRAWING No: 64-34

2. Potential Additional Supplies

(a) Ground Water

Ground-water conditions do not appear to be favourable in or near the town for the development of municipal supplies from ground-water sources.

(b) Surface Water

The ship canal should provide an adequate supply which can be readily treated.

3. Future Requirements

The maximum daily treated water demand presently exceeds the filtration capacity. By 1980 the population of the town will be approximately 15,000 persons. Consequently, the average daily demand will probably reach 2.0 mgd. Additional filters should be installed to meet increased maximum daily demands.

Similarly, the raw water demand will increase. Examination of past pumpages indicates that this may be approximately 12 mgd by 1980 and approaching the allowable withdrawal rate of 25 cfs.

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

The developed portions of the Town of Thorold are completely sewered with a system of sanitary, combined and storm sewers. Previously all sanitary, storm and private sewers discharged to the storm and industrial wastes conduit which parallels the course of the former Second Welland Canal. During 1963 a sanitary interceptor sewer was constructed on top of this conduit from Beaver Dams Road to the Townline Road where a connection is made to the St. Catharines' trunk sewer system. Presently the sanitary and combined sewers are being connected to this interceptor. One sanitary sewer on Beaver Dams Road will continue to discharge to the industrial wastes channel.

A sewage lift station serves a low lying area in the north-west corner of the town. The sewerage system is outlined in Figure 8-1.

(b) Proposed Sewage Works

The sanitary interceptor sewer has been designed to accept sanitary wastes from Thorold South and Windle Village in the Township of Thorold. Connection of these areas will be accomplished when the twinning of the Welland Ship Canal is completed. Primary treatment of these wastes will be provided at the Port Weller sewage treatment plant.

2. Refuse Disposal

Collected refuse is presently utilized in a sanitary landfill operation on the Second Welland Canal lands at the north-end of Thorold. No pollution problems are anticipated.

3. Industrial Waste Disposal

Large volumes of highly polluting industrial wastes are present in the industrial waste channel as a result of industrial activities in the Township of Thorold. Further industrial wastes are added to the channel from within the town increasing the pollution load.

Domtar Kraft and Boxboard Division discharges highly coloured wastes with excessive BOD and suspended solids to the open cut channel between Beaver Dams Road and Clifton Street.

Intermittently small quantities of a caustic cleaner containing a high concentration of solids and oily material are discharged from Interlake Steel Products Limited to a railway ditch draining to Ten Mile Creek. Rinse water with a high solids content and a high pH is discharged to the municipal sewer system.

The greatest amount of BOD and suspended solids is discharged to the industrial wastes culvert by Provincial Paper Limited.

Large amounts of BOD and suspended solids are emitted in the waste water from the Thorold Pulp Company Limited.

Plating wastes are discharged from York Electroplating Limited to the municipal sanitary sewer system. The presence of these wastes could interfere with sewage treatment processes.

4. Surface Water Quality

The results of analyses of samples obtained from the ship canal and the industrial wastes drain are summarized in Table 8-1.

The Welland Ship Canal does not deteriorate in quality in its passage through the Town of Thorold. The excessive BOD and suspended solids results indicate the polluting nature of the industrial wastes carried in the industrial wastes culvert. Serious degradation of Twelve Mile Creek results downstream.

As treatment of the contents of the channel is presently impractical it is necessary that the individual waste loadings be reduced to a desirable minimum.

IV CONCLUSIONS

Additional filtration capacity will be required to meet the increasing domestic water demands and supply maximum daily peak demands. Replacement of small diameter mains is required to improve distribution and pressures.

The construction of the industrial wastes conduit and the sanitary sewer interceptor has improved pollution problems within the town. However, connection of all sanitary sewers to the interceptor must be assured. Reduction of the strength of industrial wastes discharged to the conduit is required to improve downstream conditions. A comprehensive sewer use by-law should be enacted to protect the sewer system and future treatment facilities from harmful or toxic wastes.

TABLE 8-1

STREAM SAMPLES - TOWN OF THOROLD

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH
				Total	Susp.	Diss.				
SC 9.5	Welland Canal at Thorold St. bridge	Aug 9/60	1.2				10	240		
		Jan 17/61	3.0	176				60		
		June18/62	0.9	216			9	8,000		
		Nov 13/63	1.9	224	13	211	13.5	470		
SC 8.8	Welland Canal at Peter St. bridge	Aug 9/60	1.1				19	70		
		June18/62	1.4	216			12.5	380		
		Nov 13/63	1.7	236	22	214		530		
SC 7.1	Welland Canal at bridge Queenston Road	Aug 9/60	1.2				11	140		
		Jan 12/61	2.0	176			11	33		
		June18/62	1.6	200			13	3,000		
		Nov 13/63	2.7	206	28	178		620		
TW 10.4	Outlet to Second Welland Canal from Welland Ship Canal at Thorold weir	Jan /63	<4*	212			9.0	12,000		
		March /64	2.0	194	3.0	191	--	20	0.15	8.0
TW 10.1	Second Welland Canal at Beaver Dams Road W. bridge	May /61	145	1072	192	880		3,000		
		Oct /61	140	986	118	868		410,000		
		June /62	--	2168	--	--	53	2,570,000		
		Jan /63	195	1214	122	1092		88		
		March /64	205	1544	100	1444		150,000	3.75	7.4

TABLE 8-1 - Cont'd

STREAM SAMPLES - TOWN OF THOROLD

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	pH
TW 9.8	Second Welland Canal at Lyndon St. West	Jan /63	160	1134	115	1019		109,000		
		Mar /64	210	1468	80	1388		3,700,000	3.45	7.2
TW 8.8	Second Welland Canal at Townline Road West	Mar /64	230	1530	252	1278		1,900,000	2.12	7.9

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CHAPTER 9

VILLAGE OF CHIPPAWA

I GENERAL

The Village of Chippawa is located at the junction of the Welland River and the Niagara River. It adjoins the City of Niagara Falls. Drainage flows to the Welland River and the Niagara River. Pell's Creek, a tributary of the Welland River, drains the north-west quarter.

Essentially the village is a residential community with approximately 80 per cent of the lots developed. The 1963 population is 3,402.

Only one large industry is located within the village. Consequently, the majority of the working force is employed in the nearby industrial centres.

II WATER SUPPLIES

1. Municipal

(a) Sources

A municipal water works system operated by the Chippawa Public Utilities Commission obtains water from the City of Niagara Falls. A 12-inch diameter main from the Niagara Falls Water Filtration Plant supplies the Chippawa system. The water is metered at the plant.

(b) Treatment Works

As discussed in Chapter 4, the Chippawa supply receives screening, pre-chlorination, coagulation, sedimentation, filtration and post-chlorination.

(c) Water Consumption

During 1963 the average daily pumpage was 0.388 mgd for a per capita consumption of 114 gpcpd. Records are not available to determine the maximum pumpage rate.

(d) Water Quality

The chemical and bacteriological quality is discussed in Chapter 4. A bacteriological sampling programme of four samples per month from the distribution system was instituted late in 1963 and to date has indicated satisfactory quality.

(e) Distribution

The water works distribution system covers the total developed area within Chippawa and the area served is outlined in Figure 9-1. The system consists of approximately 11 miles of cast iron and transite mains varying in diameter from 4 inches to 12 inches. There are approximately 20 dead-ends in the system which should be looped into the network. The 4-inch diameter mains serving the older sections of the village require replacement to ensure adequate pressure and fire supply.

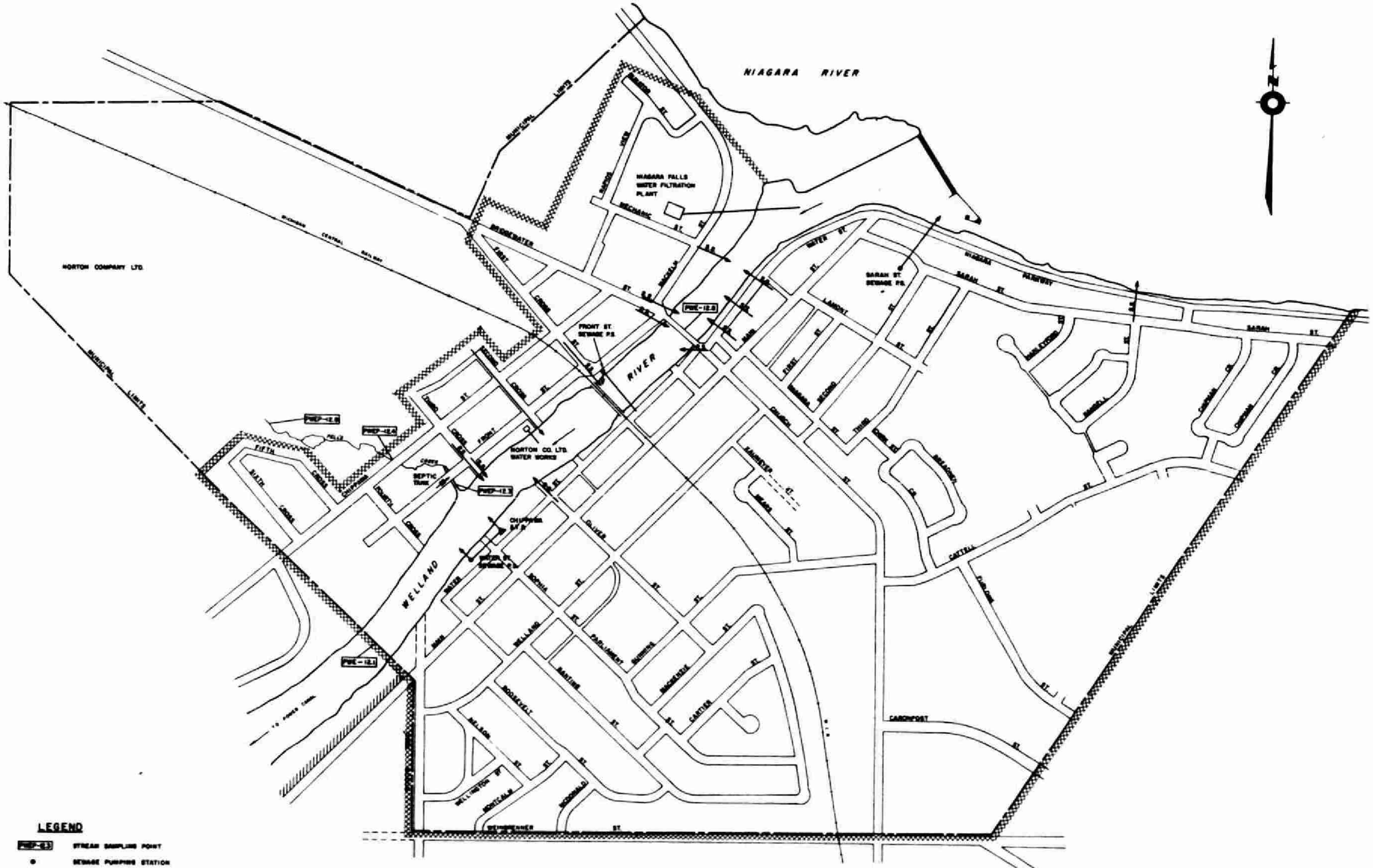
During 1963 water was supplied to 1,042 domestic, 84 commercial and 13 industrial services within the village. Only 33 services are metered. By agreement, 23 services in the Township of Willoughby and three in the City of Niagara Falls are sold water at metered rates from the Chippawa system.

There are no storage facilities available within the village. The pumping facilities at the Niagara Falls water works are considered adequate to meet all domestic and fire requirements.

2. Private Water Supplies

The Norton Company of Canada Limited pumps an average of 5.7 mgd from the Welland River for cooling purposes. The water is not treated and the quality of the water is indicated by the following sample.

Characteristics	March 4, 1964
Hardness as $CaCO_3$	134
Alkalinity as $CaCO_3$	102
Iron as Fe	0.12
Chloride as Cl	24
pH at Lab	12
Turbidity in Silica Units	2.6
Phenols in ppb	0
5-Day BOD	2.3
Colour Units	<5
Free Ammonia	0.05
M.F. Coliform Count	8



LEGEND

PWEP-12.3	STREAM SAMPLING POINT
●	SEWAGE PUMPING STATION
□—	WATER PUMPING STATION
— - —	MUNICIPAL BOUNDARY
—S.S.→	STORM SEWER
—R.S.→	RELIEF SEWER
▩	WATER AND SEWER AREA
▨	WATER AREA
▲	S.T.P. (SEWAGE TREATMENT PLANT)

ONTARIO WATER RESOURCES COMMISSION

VILLAGE OF CHIPPAWA

FIG. 9-1

SCALE:	
DRAWN BY: R.D.	DATE: APRIL 1964
CHECKED BY:	DRAWING Nº 64-26

3. Potential Additional Supplies

(a) Ground Water

Ground-water conditions do not appear to be favourable in or near the village for the development of municipal supplies from ground-water sources.

(b) Surface Water

The water from the City of Niagara Falls should provide a sufficient supply to meet the future needs of the village.

4. Future Requirements

By 1980 the population of Chippawa may approach 6,000 persons. The water supply requirements should be readily satisfied by the Niagara Falls water treatment plant.

Improvement of the distribution system including, replacement of small diameter and looping of dead-end mains is required.

III WATER POLLUTION

1. Sewage Disposal

A system of sanitary sewers serves the developed areas of the village. Domestic wastes from the north side of the Welland River are collected at a pumping station on Front Street and conveyed across to the gravity sewer on Water Street. A small pumping station on Sarah Street serves a low lying area on the south bank of the river. The main sewage lift station on Water Street lifts all the wastes into the adjacent treatment plant. Almost 90 per cent of the roof drains in the village are connected to the sanitary sewers.

The 0.3 mgd activated sludge treatment plant provides grit removal, primary settling, combined aeration-final clarification, effluent chlorination and heated sludge digestion. The chlorinated effluent is discharged to the Welland River opposite the confluence with Pell's Creek. The sewerage works are shown on Figure 9-1. Flows in excess of 0.30 mgd are automatically by-passed following primary treatment. Examination of the flow records for 1963 indicated an average daily flow of 0.29 mgd. A summary of the results of sanitary chemical analyses performed on 15 grab samples during 1962-63 follows.

Item	5-Day BOD (ppm) Avg.	Min.	Max.	% Rem.	Suspended Solids (ppm) Avg.	Min.	Max.	% Rem.
Raw Sewage	199	14	1360		320	15	2392	
Final Effluent	18.0	4.4	110	91	23.8	3.0	109	92.5

The plant operates at normal efficiency. During storm periods flow from the roof connections considerably increases the plant flow above 300,000 gpd and treatment is compromised. These hydraulic surges frequently flush the activated sludge and upset treatment processes. The plant organic loading is within acceptable limits, and efficient secondary treatment could be continuously effected if the high flows could be reduced. A local by-law has been enacted prohibiting the connection of roof drains to the sanitary sewer system. The municipality should solicit the cooperation of its citizens to sever all existing roof drain connections.

Three homes on the north side of the Welland River discharge domestic wastes to a septic tank on Front Street at Pell's Creek. The effluent discharges into Pell's Creek.

With the exception of one storm sewer outlet to the Welland River on Third Cross Street which carries industrial wastes from Norton Company Limited no problems are anticipated with polluting wastes from storm water outlets.

2. Refuse Disposal

Collected refuse is deposited at a dump within the City of Niagara Falls west of Montrose Road and north of McLeod Road. The dump site which contributes to pollution is discussed in Chapter 4.

3. Industrial Waste Disposal

The Norton Company of Canada Limited discharges industrial wastes to Pell's Creek immediately upstream from Chippawa Street and to the Welland River at Second Cross Street. Most of the flow consists of relatively uncontaminated cooling water and settling tanks are provided for the removal of inorganic material.

4. Surface Water Quality

The sample results obtained from the Welland River and Pell's Creek are included in Table 9-1.

At times the coliform count at the City of Niagara Falls intake exceeds 2,400 organisms per 100 ml, and the average phenols exceed 2 ppb. Generally, the quality of the Niagara River flowing in the Welland River through Chippawa is not noticeably effected by discharges from the sewage treatment plant or the industrial waste discharges.

The BOD and coliform count in Pell's Creek downstream from sources of industrial wastes and the septic tank outlet exceed the OWRC objectives. One sample showed a phenol concentration above two ppb.

5. Future Requirements

The septic tank on Front Street should be connected to the sanitary sewer system.

In order to reduce the hydraulic loading on the treatment plant all roof drain connections to sanitary sewers should be severed.

IV CONCLUSIONS

The present water supply source is satisfactory to meet the present and future needs of the village. Improvements in the distribution network would be advisable.

The sewage treatment plant generally provides adequate treatment at normal flows. However, the hydraulic capacity is exceeded during storm flow periods, upsetting the biological treatment process, and a large portion of the flow receives only primary treatment. All roof drain connections to the sanitary sewer system should be severed.

TABLE 9-1

SAMPLE RESULTS - VILLAGE OF CHIPPAWA

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenols (ppb)
PWE 12.1	Welland R. east	June/59	1.2	214	6		3	500	
	opposite Sodom	Feb /61	1.5	154			3	3	
	Rd. west end	June/62	1.0	208			1.5	5,100	
	of Chippawa	May /63	2.4	144			5.0	290	
		Sept/63	1.2	190	2			800	
PWEP 12.3	Pell's Cr. just	June/59	7.4	274	28			1,000	
	above outlet to	May /61	3.6	746	26	720	5	1,700	
	Welland River	Mar /64	4.2	600	35	565		6,000	6.0
PWEP 12.4	Pell's Cr. at	June/59	2.2	238	6			100	
	Chippawa Street	May /61	2.8	760	34	726	4	141	
PWEP 12.8	Pell's Cr. opposite	June/59	4.3	400	36			100	
	6th Cross Street	May /61	1.8	2462	74	2288	3	3	
PWE 12.8	Welland R. east	June/59	1.5	198	44		7	1,000	
	at bridge above	Feb /61	2.8	178			1	45	
	mouth at Niagara	June/62	1.1	194			1.3	600	
	River	May /63	2.5	136			4.0	200	
		Sept/63	1.2	188	2			3,800	

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CHAPTER 10

VILLAGE OF CRYSTAL BEACH

I GENERAL

The Village of Crystal Beach is located on the north shore of Lake Erie within the Township of Bertie. Drainage flows to Lake Erie, through the combined sewer system serving the municipality. Approximately 70 per cent of the lots are developed.

The 1963 assessed population is 1,812. However, during the summer months the population increases to approximately 6,000 or 8,000 persons as the surrounding area attracts a large summer cottage population. At times, on holiday weekends, the peak tourist influxes have been estimated at 18,000 persons.

The only large industry is the Crystal Beach Company Limited, amusement park, which depends upon the thriving tourist business.

II WATER SUPPLIES

1. Municipal

(a) Sources

Water is obtained by gravity from Lake Erie through a municipally owned water works system.

An emergency supply is obtainable through cross-connections with the Bertie Township water works system.

(b) Treatment Works

The 18-inch diameter municipal intake extends 1,800 feet into the lake and terminates in a pumpwell where coarse screening and chlorination are provided. Three service pumps deliver to the pressure filters and the distribution system. The capacity of the system is limited by the pressure filters to 1.44 mgd at a filtration rate of 2 US gpm per square foot. The pumping capacity is 5.0 mgd.

(c) Water Consumption

The average daily consumption varied from a low of 0.33 mgd in November to 0.91 mgd in June of 1963. The maximum daily consumption was 1.114 mgd during July. Based on the November water pumpage the per capita consumption was 182 gpcpd.

(d) Water Quality

Seven treated water bacteriological examinations during 1963 all indicated satisfactory results. Of the seven raw water samples five showed the presence of coliform organisms in densities varying from 2 to 64 coliforms per 100 ml. In order to monitor the treated water at least two samples per month should be obtained from the distribution system for bacteriological examination.

The chemical quality of the raw and treated water during 1963 is summarized in the following table.

	No. of	Raw Water			Treated Water		
Characteristics	Samples	Avg.	Min.	Max.	Avg.	Min.	Max.
Hardness as $CaCO_3$	6	124	108	130	124	122	128
Alkalinity as $CaCO_3$	6	97	86	102	99	94	104
Iron as Fe	6	0.19	0.15	0.30	0.13	0.07	0.22
Chloride as Cl	6	23	18	25	25	25	26
pH at Lab	6	8.1	7.8	8.4	81	7.9	8.3
Turbidity	4	1.2	0.8	1.1	0.8	0.5	1.1
Free Ammonia as N	2	0.37	0.16	0.57	0.11	0.16	0.29
Phenols in ppb	2	4	2	6	1.2	2	3

The raw water is moderately hard and the analyses for alkalinity, iron, chloride, pH and turbidity indicate a satisfactory raw and treated water. However, the phenol content at times exceeded the maximum recommended limit of 1.0 ppb, above which chlorophenolic (medicinal) taste and odours may develop. The high free ammonia concentration indicates an organically enriched water.

(e) Distribution

All of the developed area in the village is served with municipal water. The water area is shown in Figure 10-1.

Storage consists of a 100,000 gallon elevated steel tank located above the pumphouse.

The system consists of approximately 13.0 miles of cast iron mains ranging in size from 4 to 12 inches in diameter. The undersized 4-inch mains complete gridiron loops and constitute approximately 8.0 per cent of the system. There are several dead-end 6-inch diameter mains but generally distribution is good. There are 107 hydrants on the system. Three emergency cross-connections exist with the Township of Bertie water works system at the village limits; two of which are on Schooley Road and one on Ridgeway Road.

2. Private Water Supplies

The Crystal Beach Company Limited draws water from Lake Erie for operation of toilet facilities and lawn sprinklers. The supply receives chlorination and approximately 100,000 gpd are pumped daily during the 100 day operating period. The chemical quality is similar to the municipal supply.

3. Potential Additional Supplies

(a) Ground Water

Ground-water conditions do not appear to be favourable in or near the village for the development of municipal supplies from ground-water sources.

(b) Surface Water

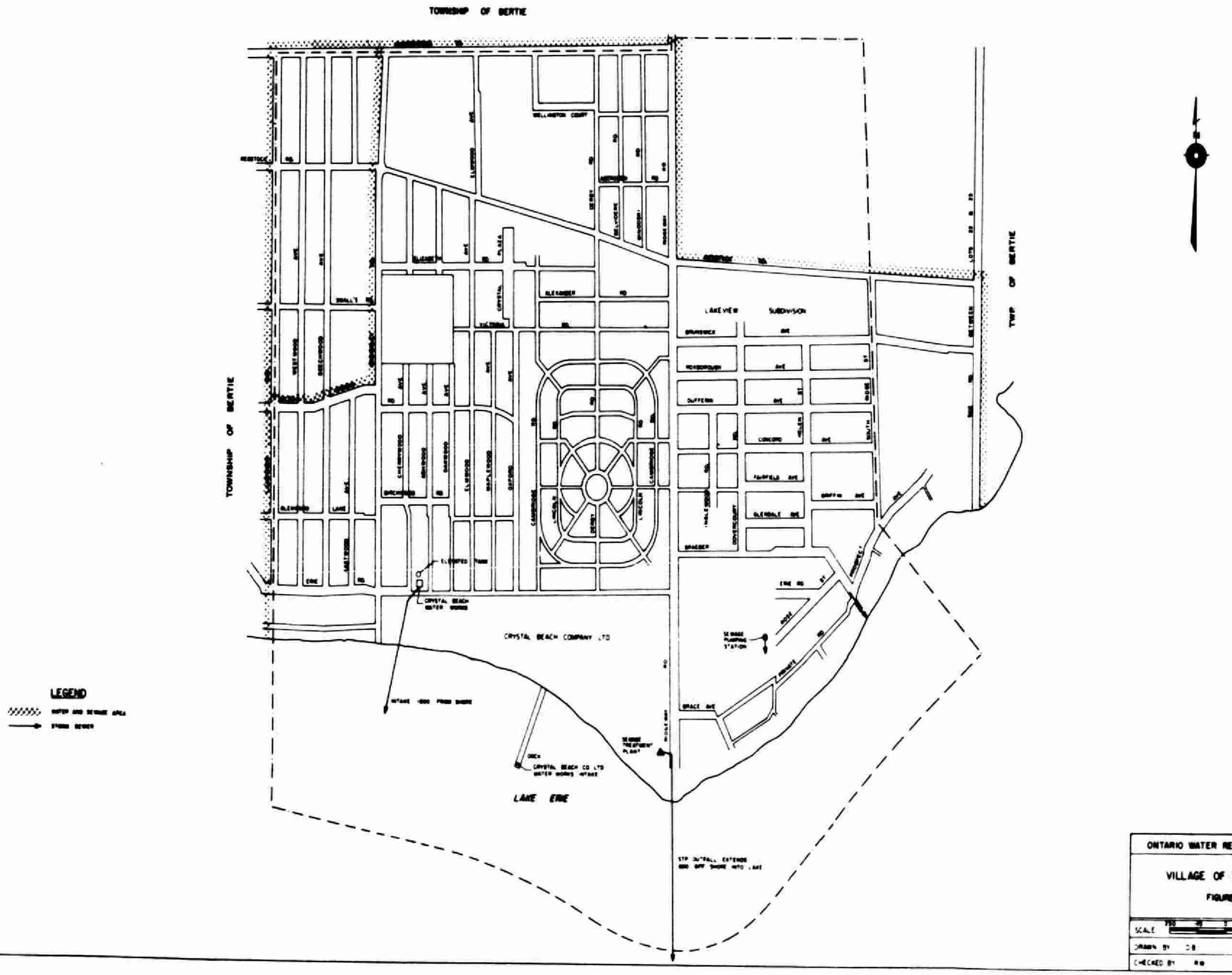
Lake Erie will supply sufficient water of suitable quality after treatment to meet the future needs of the community.

4. Future Requirements

Graphical extension of the population indicates that the 1980 year round population may approximate 2,500 persons. It is expected that the peak daily demands will exceed the capacity of the pressure filters and additional filtration capacity will be required prior to 1980.

A continual study of the chemical, physical, bacteriological, and biological quality should be carried out on both the raw and treated water to ensure that changing water conditions do not render the present facilities inadequate.

Low water levels in Lake Erie have reduced the capacity of the intake to the point where the levels in the pumpwell are insufficient for the high summer pumping rates. A low lift pump drawing directly from the intake and discharging to the pumpwell will be installed during 1964.



ONTARIO WATER RESOURCES COMMISSION

VILLAGE OF CRYSTAL BEACH

FIGURE 10 - 1

SCALE	
DRAWN BY D.B.	DATE JULY 1964
CHECKED BY R.W.	DRAWING NO 64 - 5

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

Approximately 90 per cent of the developed area is served by a system of sanitary and combined sewers discharging to the municipal treatment plant located on the west side of Ridgeway Road opposite Grace Avenue. Reference should be made to Figure 10-1. A sewage pumping station on Rose Street serves the low lying eastern area of the village. Septic tank systems serve the homes in the area bounded by Glen Spring Road, Oakwood Avenue, Birchwood Road, and Schooley Street.

The activated sludge treatment plant is considered to have a hydraulic capacity of 0.30 mgd. Treatment consists of coarse screening, aeration, final settling and chlorination. Accumulated sludge is periodically removed to surrounding farmland. An outfall sewer extends approximately 600 feet into Lake Erie.

In addition to the wastes from Crystal Beach, the plant receives domestic sewage from approximately 100 cottages in the bay beach area.

A summary of results of ten composite samples submitted to the OWRC during 1962-63 follows.

	5-Day BOD				Suspended Solids			
	Avg.	Min.	Max.	% Removal	Avg.	Min.	Max.	% Rem.
Raw Sewage	37.3	12	82	--	57.8	13	84	--
Final Effluent	30.7	6	86	17.7	46.7	16	100	11.5

The raw sewage was very dilute and the treatment plant has very little effect in reducing the strength sufficiently to meet effluent quality objectives.

During storm periods, the activated sludge process is washed out and treatment curtailed. In addition all the treatment units are covered and the condition of the plant cannot be readily observed. The sludge return facilities are inefficient and sludge storage inadequate. Primary sedimentation is lacking. No facilities are available to meter sewage flows.

(b) Proposed Sewage Works

In a 1961 report, Canadian-British Engineering Consultants pointed out that after extensive renovation of the plant, efficient treatment could be provided for a population of approximately 2000 persons. However, the loading contributed by the greater summer population would overload the works.

2. Refuse Disposal

Collected refuse is burned in a privately owned incinerator located north-west of the village in the Township of Bertie.

3. Industrial Waste Disposal

There are no sources of industrial wastes within the village.

4. Surface Water Quality

The only source of pollution within the village is the sewage treatment plant outfall. During a survey of the bacteriological quality of the beach area on October 26, 1962, gross pollution was not evident. However, conditions were not ideal for survival of the bacteria at the time of the survey. In addition, the plant was not loaded heavily at this time. It can be expected that the coliform densities would be greater during the summer period.

Conditions in the Crystal Beach area are ideal for growth of the algae Cladophora. Particularly heavy growths are noted to a depth of approximately ten feet extending 200 feet from shore from the Crystal Beach Company Limited pier eastward. The discharge from the sewage treatment plant tends to make the growths appear earlier and persist longer than Cladophora growths in other similar areas of Lake Erie.

5. Future Requirements

Improved sewage treatment works capable of accommodating fluctuating loads are required. Either a mechanical treatment plant with a multiplicity of units or a multi-celled waste stabilization pond should be considered.

A flow metering device should be installed at the present plant to aid in the design of improved treatment facilities.

In addition the outfall should be extended to disperse the organic nutrients stimulating algae growth into deeper water where Cladophora do not survive.

IV CONCLUSIONS

The water works provides generally suitable treatment and has sufficient capacity to meet present water demands. However, prior to 1980 the filtration capacity will be exceeded during the peak summer season and additional filtration capacity will be required. Pre-treatment facilities, providing coagulation and sedimentation would be advisable.

The present sewage treatment plant is inadequate. A multiple unit secondary treatment plant or multi-celled lagoon capable of operating efficiently during both the summer peak loadings and the winter period should be provided. Extension of the outfall sewer is vital for protection of the shore waters.

CHAPTER 11

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CHAPTER 11

VILLAGE OF FONTHILL

I GENERAL

The Village of Fonthill is located on the watershed dividing the drainage basins of Twelve Mile Creek and the Welland River. Drainage flows to the Welland Ship Canal, the Welland River and Twelve Mile Creek.

The assessed population in 1963 is 2,572. The village is strictly a residential community with the residents commuting to work in the neighbouring industrial centres.

II WATER SUPPLIES

1. Municipal

(a) Sources

A municipally owned water works system obtains water from a 50 foot deep, 12-inch diameter drilled well located in the centre of Fonthill.

A spring, flowing to an open collection pond in the north end of the village is utilized as a standby supply.

(b) Treatment Works

The municipal well water receives no treatment. A hypochlorinator is available to disinfect the emergency spring supply.

The municipal well pump is rated at 450 gpm or 0.648 mgd while the spring supply can pump 50 gpm or 0.072 mgd. The estimated capacity of the well is 0.85 mgd.

(c) Water Consumption

The average daily consumption during 1963 was 0.181 mgd. The per capita consumption was approximately 71 gpcpd. The maximum daily consumption of 0.60 mgd occurred frequently during the summer months.

(d) Water Quality

During 1963, a total of 65 samples obtained by the Welland and District Health Unit each contained zero coliform oganisms, indicating that the water is bacteriologically satisfactory. An untreated sample from the spring supply contained 127 coliforms per 100 ml.

The chemical water quality as indicated by past sampling is shown in the following.

Characteristics	No. of Samples	Well Supply Avg.	Min.	Max.	No. of Samples	Spring Supply
Hardness as $CaCO_3$	5	285	281	290	1	342
Alkalinity as $CaCO_3$	5	210	195	226	1	234
Iron as Fe	5	0.04	0	0.12	1	0.09
Chloride as Cl	5	20.4	18	26	1	28
pH at Lab	5	7.6	7.4	7.9	1	0.1
Fluoride as F	5	0.04	0	0.1		430
Total Solids	1	342	--	--		
Calcium as Ca	2	73	70	77	1	77
Nitrate as N	1	4.4			1	--
Free Ammonia as N	1	.03			1	0.05
Turbidity Units						0.6

The well water is hard but according to the analyses performed is of excellent chemical quality for domestic consumption. The nitrate level is relatively high.

(e) Distribution

All of the developed area within the municipality is served by the municipal system consisting of nine miles of 6 and 8-inch cast iron mains. The area served by water is outlined in Figure 11-1.

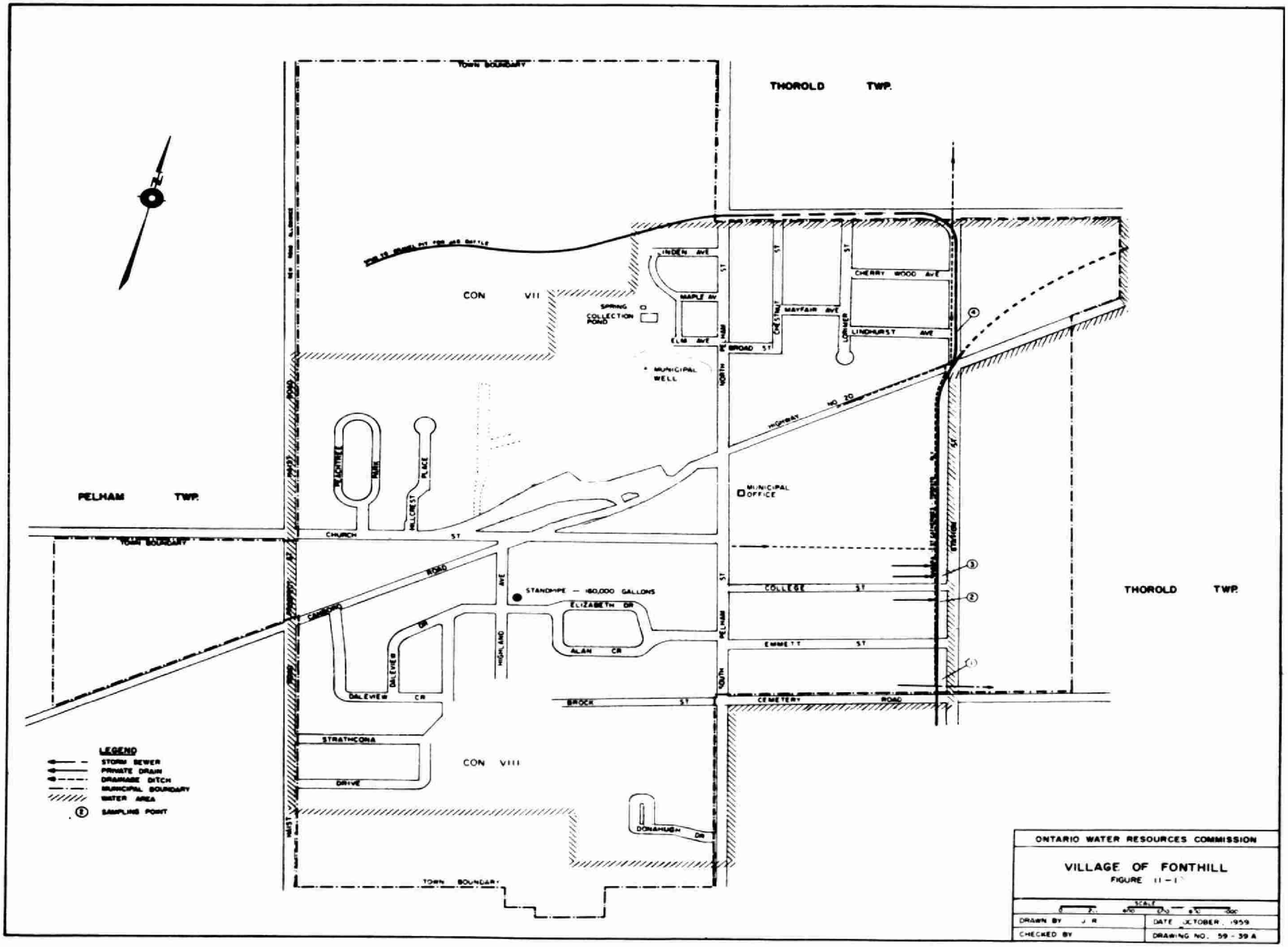
There are 769 services all of which are metered. There are 75 hydrants located throughout the system.

Storage consists of a 160,000 gallon standpipe located near the highest elevation within the village. This is satisfactory to maintain a constant pressure throughout.

2. Potential Additional Supplies

(a) Ground Water

Conditions appear to be favourable near the village for the development of additional municipal supplies from ground-water sources. Before any test drilling is undertaken, a ground-water survey should be carried out to determine areas where ground-water conditions may be the most suitable.



ONTARIO WATER RESOURCES COMMISSION

VILLAGE OF FONTHILL

FIGURE II-1

DRAWN BY J R
DATE OCTOBER, 1959
CHECKED BY
DRAWING NO. 59 - 39 A

(b) Surface Water

The City of Welland maintains a ground level reservoir with a capacity of 500,000 gallons in the township, adjacent to the village. An emergency or permanent connection to this water supply could be secured to augment the present municipal well. However, the capacity of the feeder main from the City of Welland would have to be increased to meet the demands of the village.

3. Future Requirements

The projected population of Fonthill for 1980 may approximate 5,000 persons. The average daily demand will probably be in the neighbourhood of 350,000 gpd. The present supply will be capable of meeting the average demand but the peak demands will greatly exceed the capacity of the present facilities.

In addition the present facilities are not capable of producing the fire fighting requirements. Increased well capacity and storage facilities are needed to meet the fire fighting and the future domestic demands.

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

All of the residences within the village are served by individual septic tanks and tile beds. The soil is sandy and generally suitable for the operation of these systems. However, in the eastern part of the village, south of highway 20, private drains containing polluting wastes discharge to the railway ditch which drains towards the Welland Ship Canal via the Port Robinson Road ditch. Odours are caused by septic sewage ponding in the railway ditch. Approximately 50 homes are tributary to these drains.

It should be noted that tile bed systems at higher elevations have malfunctioned. The lack of an adequate storm sewer system has intensified these problems.

(b) Proposed Sewage Works

Past OWRC reports have advised the development of a municipal pollution abatement program including a system of sanitary sewers and treatment facilities.

2. Refuse Disposal

Collected refuse is hauled to the Township of Thorold open dump. Problems associated with this dump site are discussed in Chapter 16.

3. Industrial Waste Disposal

There are no sources of industrial wastes within the village. The Canadian Canners Limited, Plant No.50, has been closed for some years and there is no indication that this operation will resume.

4. Surface Water Quality

The results of sanitary chemical and bacteriological examinations of samples obtained from outlets and surface drainage ditches are given in Table 11-1 and sampling points are shown on Figure 4-1.

Evidence of domestic sewage exists in the private drains and railroad ditch. This constitutes a public health hazard.

5. Future Requirements

As the population density increases the ability of the soil to absorb septic tank effluents, will probably be exceeded. Saturation of the topsoil with septic sewage and surface ponding in depressions may occur. To prevent the development of such a public health hazard a system of sanitary sewers and a sewage treatment plant should be provided.

In the meantime, the municipality should locate and sever septic tank connections to the drains tributary to the railway ditch. Provision of suitable private disposal systems is necessary until a municipal system is constructed.

IV CONCLUSIONS

To meet the needs of the expanding population, the Village of Fonthill requires additions to the municipal water works system and the development of sanitary sewers and sewage treatment facilities.

A consulting engineer should be retained to report on the requirements to meet increased fire and future domestic demands. Increased storage and an additional well should be provided. A ground water survey of the area to locate possible ground water sources should be implemented.

A consulting engineer should also be retained to prepare a report on the provision of sanitary sewers and sewage treatment.

TABLE 11-1

SAMPLE RESULTS - VILLAGE OF FONTHILL

Location	Date	5-Day BOD	Solids Total	Solids Susp.	Solids Diss.	M. F. Coliform per 100 ml
Railroad ditch south end	Sept/63	560	978	154	824	more than 15,000,000
Sewer outlet south of College St.	May /62	85	1268	342	920	15,000,000
Sewer outlet north of College St.	May /61	11	580	40	540	
	May /62	94	1938	382	1556	38,000,000
Railroad ditch north end	May /61	2.8	456	36	420	more than 15,000,000
	Sept/63	48	768	45	723	

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CHAPTER 12

TOWNSHIP OF BERTIE

I GENERAL

The Township of Bertie is located in the south-east corner of the county. Drainage is generally to the Niagara River via Black and Beaver Creeks, Miller Creek and Frenchman Creek. However, a narrow strip of land along the southern edge drains to Lake Erie by means of local ditches, award drains and Six Mile Creek.

The main concentrations of permanent population are the communities of Ridgeway and Stevensville. Dense summer cottage development stretches from Fort Erie west to Crystal Beach in the Erie Beach, Waverly Beach, Crescent Park, Buffalo Heights, Thunder Bay, Oakhill-Forest, Ridgewood, Bay Beach and Abino Point areas. There are large numbers of permanent homes in the first three areas.

The assessed population of the township is 8,567. The actual summer resident population of the area has not been accurately estimated.

The livelihood of the township is mainly derived from the tourist attractions supported by the recreation facilities along the Lake Erie beach and the Fort Erie racetrack. However, there is also some agricultural activity and minor industrial operations.

II WATER SUPPLIES

1. Municipal

(a) Sources

The Ontario Water Resources Commission operates a water works drawing water from Lake Erie at the south-end of Rosehill Road. This source serves the extensive municipally owned water works distribution system.

(b) Treatment Works

The Lake Erie water receives coarse screening, micro-straining, and pre and post-chlorination prior to pumping. The intake is 42 inches in diameter and extends 1800 feet into Lake Erie into 20 feet of water.

The capacity of the low and high lift pumping facilities are 9.0 mgd and 6.6 mgd respectively. As the low lift pumps can only be operated in increments of 3.0 mgd, the full capacity of the 4.5 mgd microstrainer cannot be utilized. To meet peak demands it is necessary to by-pass the microstrainer. The design allows for the installation of an additional 4.5 mgd microstainer.

(c) Water Consumption

The average daily pumpage during 1963 was 1.06 mgd. The average daily pumpage fluctuated from 0.599 mgd in March to 2.255 mgd in July. The maximum daily pumpage was 3.552 mgd. The estimated per capita consumption was 75 gpcpd.

(d) Water Quality

A total of 53 treated water samples was examined during 1963 for bacteriological quality. All but two samples contained zero coliforms per 100 ml. Based on these results the bacterial quality was satisfactory. Nineteen raw water samples were examined of which 17 contained coliform organisms. The average coliform density was 250 coliforms per 100 ml and the maximum was 3,100 coliforms per 100 ml.

The chemical and physical quality of the water is indicated by the following analyses.

	No. of	Raw Water			Treated Water		
Characteristics	Samples	Avg.	Min.	Max.	Avg.	Min.	Max.
Hardness as $CaCO_3$	3	136	130	144	--	--	--
Alkalinity as $CaCO_3$	3	102	106	112	--	--	--
Iron as Fe	7	0.29	0.12	0.39	--	--	--
Chloride as Cl	3	22	19	24	--	--	--
pH at Lab	7	8.0	7.7	8.4	--	--	--
Turbidity Units*	365	4.8	--	15.3	3.8	--	11.2

* Turbidity determinations of the raw and treated water are made daily by the plant operators.

The water is moderately hard and according to the analyses performed constitutes an excellent source of drinking water. The turbidity of the treated water at times exceeds the recommended limit of 5.0 units. During January and December of 1963 the average turbidities were high.

Lake Erie is particularly favourable for the growth of algae. During the summer period biological growths are numerous in the raw water. Microstraining has been successful in removing most of these organisms and difficulties with tastes and odours have not been experienced.

(e) Distribution

The extensive distribution network area is outlined in Figure 12-1. The system serves 3,160 domestic, 185 commercial and 5 industrial consumers. Only 42 meters are employed. The estimated population served during the summer months is 14,200 persons. The system consists of approximately 72.5 miles of mains ranging in diameter from 4 to 14 inches. Approximately 5.0 per cent of the mains are less than 6 inches in diameter.

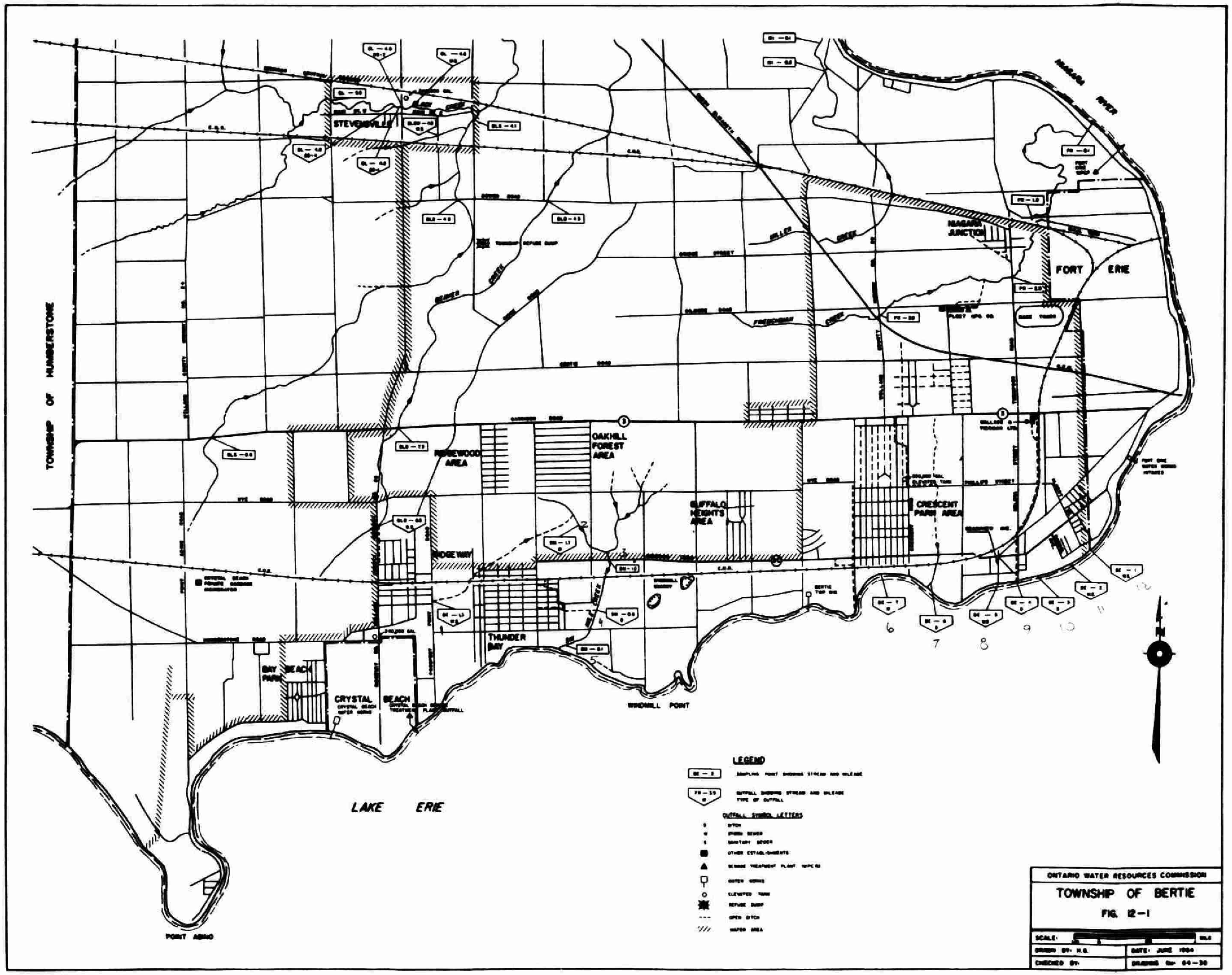
The distribution system is cross-connected with the Fort Erie water works system at five locations and with the Crystal Beach water works system at two locations.

The clear well at the treatment plant has a storage capacity of 125,000 gallons. Pressure storage is provided by two 240,000 gallon standpipes and a 256,000 gallon elevated storage tank. One standpipe at Ridgeway Road and Thunder Bay Road serves the Community of Ridgeway and the other which serves Stevensville is located east of Hwy 58 and south of the NYCR. The elevated tank is located in the Crescent Park area.

2. Private Water Supplies

Two private water works are located in the township. The Douglastown water works draws from Black Creek and serves the Community of Douglastown in the Township of Willoughby. This supply is discussed in Chapter 18. A private water works system also serves the Niagara Christian College.

The Niagara Christian College water works obtains water from the Niagara River. Treatment consists of chlorination. Approximately 2,000 gpd are pumped to serve the 100 residents at this private boarding school. The water quality is indicated by the following samples obtained from 1959 to 1964.



ONTARIO WATER RESOURCES COMMISSION

TOWNSHIP OF BERTIE

FIG. 12-1

Characteristics	No. of Samples	Treated Water Avg.	Min.	Max.
Hardness as $CaCO_3$	4	134	124	144
Alkalinity as $CaCO_3$	4	98	96	102
Iron as Fe	4	0.42	trace	0.76
Chloride as Cl	4	29	22	28
pH at Lab	4	7.9	7.6	8.1
Colour in Hazen Units	1	5	--	--
Turbidity in Silica Units	3	11.1	6.5	20.0
M.F. Coliform Count	10	0	0	0

The water is moderately hard and the iron content and turbidity of the supply generally exceed the respective objectives of 0.3 ppm and 5.0 ppm. The treated water bacteriological quality has been satisfactory according to the limited sampling performed.

Rural water supplies are obtained from private drilled wells.

3. Potential Additional Supplies

(a) Ground Water

Additional ground-water supplies are available in the township for domestic needs and can be developed as they are required. Aquifers in the upper parts of the bedrock usually yield fresh water to private wells. Deeper drilling may result in mineralized water. Supplies obtained from the bedrock aquifers are usually sufficient for domestic needs.

(b) Surface Water

Lake Erie and the Niagara River constitute suitable water supply sources to meet the future needs of the township.

4. Future Requirements

The municipal water works system supplies a sufficient quantity of water to meet the present needs of the water area. There is little industrial water use and much of the developed area consists of summer cottages. In the future, this may change and the per capita demand increase. As the full capacity of the microstrainer is not usable and peak demands require by-passing, it would be advisable to install an additional microstrainer as soon as finances are available.

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

With the exception of a portion of the Bay Beach area which is sewered and is connected to the Crystal Beach sewerage system, and also the Fleet Manufacturing Company Limited which has its own sewage treatment plant, residences in the Township of Bertie are served by individual waste disposal systems. The heavy clay soil, flat topography and poor drainage characteristics, and the relatively shallow overburden cause frequent malfunctioning of septic tank tile bed systems. Pollution problems are evident in the developed communities of Rideway, Stevensville, Erie Beach, Waverly Beach and Crescent Park.

Ridgeway

The Community of Ridgeway has a population of approximately 1,500 persons. Samples obtained from storm ditches discharging north to Beaver Creek and eastward via the Mann Award Drain to Six Mile Creek have contained excessive coliform counts, BOD and suspended solids concentrations indicative of domestic sewage pollution. Seepage or direct discharge of septic tank overflows to the local storm sewers is probably the cause.

Stevensville

Investigations in the Community of Stevensville have indicated that three storm sewers discharging to Black Creek contain wastes of domestic sewage origin. A number of private residences also have direct connections to Black Creek. Discharges and seepage from malfunctioning sewage disposal systems in the community of 500 persons is causing considerable pollution of Black Creek.

Erie Beach and Waverly Beach

These two adjoining communities have a permanent population of approximately 780 persons and a summer population of roughly 1650 persons. Many of the lots are too small for adequate subsurface disposal of septic tank overflows. This is emphasized by the adverse results which have been obtained from the local storm drains.

A portion of Waverly Beach is served by a communal settling tank which overflows to the Lake Erie Beach. Storm sewers serving Erie Beach discharge at the end of Albert Street and west of Bardol Street. Similarly, Waverly Beach is served by two storm sewers discharging to Lake Erie at the ends of Helena Street and Beachview Avenue.

Crescent Park

Most of the road ditches in the Crescent Park area are connected to a local watercourse east of Crescent Road which flow to Lake Erie. The road ditches are contaminated with seepage from septic tank systems. In addition, sample results from the Daytona Road storm sewer indicate the presence of domestic wastes.

Similar conditions have been noted in the open ditches draining the areas known as Bertie Bay, Windmill Point, and Point Abino.

Fleet Manufacturing Company Sewage Treatment Plant

Sanitary wastes from approximately 250 employees flow to a septic tank and are then pumped to two standard rate trickling filters capable of accepting wastes from 1,880 persons. The effluent is chlorinated prior to final settling in a humus tank, and is discharged to a drainage ditch tributary to Frenchman Creek.

The degree of treatment is indicated by seven grab samples (1963) of the septic tank overflow and of the final effluent.

	Avg.	Min.	Max.	Avg.	Min.	Max.
Septic Tank Eff.	23	21	46	15	6	33
Final Effluent	7.7	1.2	20	7.7	2	21

The effluent from the plant has been satisfactory. The operation of the plant should be maintained to protect the small ditch, and avoid nuisance conditions.

(b) Proposed Sewage Works

In municipal pollution survey reports, the Commission has advised that sanitary sewers and municipal treatment works be provided for the communities of Stevensville, Ridgeway, Erie Beach, Waverly Beach and Crescent Park.

2. Refuse Disposal

Refuse is disposed of at a site south of Stevensville, in the Beaver Creek watershed. An overflowing well on the property discharges to a pond used for fire protection, but when the pond is full the excess water is diverted to an area where garbage has been deposited on the land surface. Leachate from the dump then escapes to the woods and could reach Beaver Creek. It was originally intended that all garbage would be buried in trenches but this has been carried out only to a limited extent.

Collected refuse from Crystal Beach is incinerated at a private installation north-west of the village.

3. Industrial Waste Disposal

Plating and metal cleaning wastes are discharged from Fleet Manufacturing Company Limited to the drainage ditch tributary to Frenchman Creek.

Wallace and Tiernan Limited discharges process wastes which are alkaline or acidic and high in suspended solids to an open ditch approximately 1.75 miles above Lake Erie.

Two small slaughterhouses operate in the township. One of these, the Stanley House slaughter operation contributes contaminated wastes high in BOD, suspended solids and coliform density to a tributary stream of Black Creek.

4. Surface Water Quality

Sampling point locations appear on Figure 12-1. The largest stream in the township, Black Creek, has been sampled regularly each year. The remainder of the streams were sampled in 1959 and 1961 and pollution surveys were performed in tributary areas. The results of samples from these streams and contaminated outfalls are included in Table 12-1.

Upstream from Stevensville, Black Creek intermittently contains high BOD concentrations and coliform densities presumably from agricultural drainage. Polluting materials from storm sewers and private drains at Stevensville and Ridgeway raise the coliform counts in Black and Beaver creeks to excessive levels which persist to the mouth of Black Creek.

The coliform densities and BOD concentrations in the

Prospect Point Road ditch flowing south through Ridgeway were excessive and constituted a public health hazard. BOD concentrations in Six Mile Creek at mileage point SM1.0 have been excessive.

Miller Creek appears to be of generally satisfactory quality although a BOD level of 5.0 ppm has been recorded at mileage point ML0.1 in 1960. Similarly, the quality of the water in Frenchman Creek is fairly good except for the occasional high BOD or coliform count downstream from the Fleet Manufacturing Company Limited sewage treatment plant.

5. Future Requirements

The development of municipal sanitary sewerage systems for both Ridgeway and Stevensville should be considered. These areas are fairly densely developed and as the population increases problems created by saturating the topsoil with septic tank overflow will worsen.

Similarly, sewage works should be developed in the communities of Erie Beach, Waverly Beach and Crescent Park. Each year the number of residences which are occupied the year-round increases, and conditions may be expected to deteriorate.

CONCLUSIONS

The Township of Bertie water treatment plant provides a good quality water in sufficient quantity to meet the present demands of the area served. However, growth is proceeding rapidly and the installation of a second microstrainer will be required to increase the plant capacity to 9.0 mgd.

Since much of the livelihood of the township is derived from the tourist industry attracted by the Lake Erie Beach, it is in the best interests of the township to protect the shoreline from pollution. Sewerage works are required in the communities of Stevensville, Ridgeway, Erie Beach, Waverly Beach and Crescent Park. Where feasible an integrated sewage scheme should be developed for the affected areas.

The municipal refusal disposal is not satisfactory. The overflowing well should be diverted away from the disposal area and sanitary landfill should be practised.

TABLE 12-1

SAMPLE RESULTS - TOWNSHIP OF BERTIE

BLACK CREEK

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
				Total	Susp.	Diss.				
BL 1.6	Black Cr. at Queen Elizabeth Hwy.	July/59	9.6	312	24	288		1,000,000		
		Aug /60	5.0				78	700		
		May /61	1.8	464	92	372		1,120		
		May /63	3.6	578			110	4,900		
BL 4.1	Black Cr. just above junction with south branch	Aug /60	5.0				79	500		
		July/61	1.6	714	140	574	--	260		
		Apr /62					--	38,000		
		May /63	1.0	480			62	110,000	3.2	215
BLB 4.3	Beaver Cr. Stevensville - Bowen Rd.	July/59	11.0	584	26	558		<10,000		
		May /61	1.0	652	8	644		113		
		May /63	1.4	570			2.8	3,800	0.5	65
BL 4.5WS	12" drain to Black Cr. east end of Stevensville	May /61	175	610	70	540		84,000,000		
		Apr /62	72.0	592	48	544		600,000		
BL 4.8 DSI	Outfall to Black Cr. S.E. corner of county road #28	July/59	40.0	654	60	594		17,000,000		
		Apr /62	27.0	732	42	690		1,830,000		

TABLE 12-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF BERTIE

BLACK CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
BL 4.8 DS3	Outfall to Black Cr. N.W. corner of county road #28	May /61	96	466	56	410		790,000		
		Apr /62	580	1072	178	894	--	36,000,000		
BL 4.8 DS4	Outfall to Black Cr. S.W. corner of county road #28	May /61	8.0	442	20	420		150,000		
		Apr /62	11.0	588	122	466	--	164,000		
BLS4.8	Black Cr. south branch at Bowen Road	July/59	11.0	2452		2434		<10,000		
		Aug /60	14.0				42	4,000		
		May /61	7.0	1392	18	1374		610		
		May /63	2.6	1342			29	5,000	1.8	110
BL 5.0WS	Outfall to Black Cr. west end of Stevensville	Apr /62	30	504	56	448	--	1,890,000		

TABLE 12-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF BERTIE

BLACK CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M. F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
				Total	Susp.	Diss.				
BL 5.5	Black Cr. first conc. north of Stevensville	July/59	18.0	530	52	478		10,000		
		Aug /60	12.0				51	980		
		May /61	11.0	440	20	420		570		
		July/61	2.4	506	58	448		230		
		Apr /62						52		
		May /63	5.2	430				310	2.0	215
BLB 7.3	Beaver Cr. at Old Garrison Rd.	July/59	2.3	2240	--	--	17	58,000		
		May /61	6.0	1136	--	--		7,000		
		May /63	1.2	1166	--	--	1.0	7,600	0.35	60
BLB8.3 D	County rd. #28 ditch north of Ridgeway	Apr /62	27.0	570	282	288		70,000		
BLS8.6	Black Cr. south branch at Old Garrison rd.	July/59	15.0	398	76	322		40,000		
		May /61	5.2	330	62	268		860		
		May /63	3.2	300			48	4,100	2.2	210

TABLE 12-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF BERTIE

SIX MILE CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
				Total	Susp.	Diss.				
	Ridgeway-Prospect Point rd. ditch north of Hazel St.	Apr /62	25.0	294	24	270		212,000		
	Ridgeway-Prospect Pt. rd. ditch at Hibbard St.	Apr /62	7.6	366	22	344		160,000		
	Ridgeway-Prospect Point rd. ditch at Cutler St.	Apr /62	82	432	66	366		2,600,000		
	Ridgeway-Prospect Point rd. ditch at #3C Highway	Apr /62	36	652	48	604		2,700,000		
SM 0.1	Six Mile Cr. just above mouth at Lake Erie	July/59 May /61	2.5 2.6	254 270	24 18	230 252	-- --	40 30		

TABLE 12-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF BERTIE

SIX MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
BE 11.D	Thunder Bay Drain to Six Mile Cr.	May /61	4.2	372	34	338	--	120		
SM 0.6D	Thunder Bay Drain at Six Mile Cr.	May /61	2.8	360	18	342	--	350		
SM 1.0	Six Mile Cr. at Hwy. 3C	July/59	12.0	366	44	322	--	100		
		May /61	4.4	338	8	330	--	30		
BE 12DS	Mann Award Drain at Prospect Pt. rd. Ridgeway	July/59								
		May /61	4.2	304	24	280	--	42		
		Apr /62								
SM 1.7D	Mann Award Drain to Six Mile Cr. from Ridgeway	May /61	5.3	296	16	280	--	--		
		Apr /62	-	oily material present				115,000,000		
BE 13WS	Ridgeway-Mann Award Drain at Prospect Pt. Rd.	Apr /62	-	contained oily material				115,000,000		

TABLE 12-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF BERTIE

SIX MILE CREEK - Cont'd

	Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
					Total	Susp.	Diss.				
	BE 1WS	Ridgeway-Railroad ditch east of Prospect Pt. road	Apr /62	61.0	830	384	446	--	52,000		
12	BE 1WS	Erie Beach Albert St. storm sewer	July/59	37.0	378	74	304		10,000,000		
			Apr /62	57.0	416	46	370	--	150,000		
11	BE 2WS	Erie Beach Bardol St.-storm sewer	Apr /62	5.4	212	8	204	--	9,000		
10	BE 3S	Waverly Beach outfall from tank	Apr /62	6.0	280	12	268	--	15,000		
9	BE 4D	Waverly Beach storm sewer outfall Helena St.	Apr /62	5.6	362	20	342	--	6,700		

TABLE 12-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF BERTIE

SIX MILE CREEK - Cont'd

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
BE5	Waverly Beach Beachview Ave. storm sewer	Apr /62	12.0	348	44	304		> 150,000		
BE6D	Crescent Park ditch east of Crescent road	Apr /62	3.6	296	26	220		900		
BE7W	Crescent Park Daytona Road storm sewer	Apr /62	13.0	288	38	250		187,000		

MILLER CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
Mi 0.1	Miller Cr. at river road	July/59	1.6	190	--	--	10			
		June/61	5.0	342			6.0	350		
Mi 0.5	Miller Cr. at road ½ mile above mouth	July/59	3.8	360			91			
		June/61	2.0	920			17	450		

TABLE 12-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF BERTIE

FRENCHMAN CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
F 0.1	Frenchman Cr. at	June/59	3.4	432	8	424	18	3,400		
	river road	Aug /60	2.1				6	50		
		May /61	2.8	828			18	20		
F 1.8	Frenchman Cr. at	June/59	4.9	502	12	490	13	152		
	road south of	Aug /60	1.9				8	17,000		
	golf course	May /61	4.0	486			5	300		
F 2.5	Frenchman Cr. at	June/59	7.4	276	34	242	18	0		
	conc. road 2	Aug /60	4.1				13	510		
	Bertie Twp.	May /61	3.6	314			7	17		
F 3.7	Frenchman Cr. at	June/59	3.4	340	32	308	82	7,150		
	Queen Elizabeth	May /61	2.8	314			7.0	190		
	Highway									

CHAPTER 13

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CHAPTER 13

TOWNSHIP OF CROWLAND

I GENERAL

The Township of Crowland lies in the central portion of the county and is bounded on the west by the City of Welland and on the north by the Welland River. The township lands are drained by the river and its several tributaries, of which the largest are Lyon's and Tee creeks.

The assessed population of the township is 1,893 and the economy is mainly agricultural. The only sizeable community is Cooks Mills which is located due east of the City of Welland. The Ford Motor Company of Canada Limited, is the one large industry in the township.

II WATER SUPPLIES

1. Municipal

The City of Welland supplies water to 114 flat rate services in the township, on East Main Street and on Ontario road.

2. Private Water Supplies

The Ford Motor Company of Canada Limited, Glass Fabricating Operation, draws water from the Welland River. The water is pre-chlorinated and clarified in a solids contact unit employing alum and coagulant aids. The water thus treated is suitable for process purposes but the water for domestic purposes is further treated by rapid-sand filtration, carbon filtration, and post-chlorination.

The quality of the raw and treated water as determined by a series of seven samples collected in 1963, is recorded as follows.

	Raw Water			Treated Water		
Characteristics	Avg.	Min.	Max.	Avg.	Min.	Max.
Hardness as $CaCO_3$	137	124	164	136	128	144
Alkalinity as $CaCO_3$	106	88	134	78	38	105
Iron as Fe	1.09	0.23	4.4	0.27	0.1	0.4
Chloride as Fe	26	24	30	30	27	37
pH at Lab	8.1	7.1	8.7	7.2	6.3	7.9
Colour in Hazen Units	<18	<5	65	<5	<5	<5
Turbidity in Silica U.	13.2	2.9	40	8.8	1.1	40
Phenol in ppb	3.0	0	9	2.1	0	5
BOD	3.2	0.4	7.6	-	-	-
Free Ammonia as N	2.6	0.16	11.0	5.4	1.3	7.9

At times the water contains excessive concentrations of iron, phenol, turbidity and ammonia. The adverse raw water quality is attributable to discharges from upstream industries and sewage from the City of Welland.

A large number of the rural home owners employ cistern water supplies as many of the drilled wells contain hydrogen sulphide.

3. Potential Additional Water Supplies

(a) Ground Water

Additional supplies are available in the township for domestic needs. Overburden aquifers occur sporadically, but bedrock aquifers constitute the main source of water for drilled wells. The township is underlain mainly by rocks of the Salina formation which is a known producer of mineralized water. However, available well records suggest that fresh supplies can often be obtained from the upper zones of the bedrock.

(b) Surface Water

There is no suitable source of surface water within the township, however, further supplies could be developed from the Welland Ship Canal which passes near the north-western boundary.

4. Future Requirements

The City of Niagara Falls and City of Welland water works systems provide potential sources of water supply for developing areas adjacent to these cities.

To ensure satisfactory raw water for the Ford Motor Company, the intake could be relocated to obtain Niagara River water or the company could provide lagoon storage and draw water from the Welland River during periods when the water quality is satisfactory. The company could also consider the reuse of process waste water. Water might also be obtained from the City of Niagara Falls.

Since the development is mainly rural, the need for municipal water supply is limited to suburban areas adjacent to Welland.

III WATER POLLUTION

1. Sewage Disposal

The homes in the township are generally served with septic tank and tile bed systems. There does not appear to be any serious water pollution resulting from these. There are no proposals at present for the development of municipal sewage works.

The Ford Motor Company is served with a Hays Process, solids contact sewage treatment plant. The treatment units consist of a coarse bar screen, oxidation tank, final settling tank, aerobic digester and a chlorine contact chamber. The results of ten sets of grab samples collected in 1963 are summarized as follows.

	Raw Sewage			Treated Effluent			%
Characteristics	Avg.	Min.	Max.	Avg.	Min.	Max.	Efficiency
5-Day BOD	161	18	290	41	0.4	96	74.5
Suspended Solids	230	36	622	39	9	96	83.0

The average BOD and suspended solids concentrations exceed the OWRC objectives of 15 ppm for discharge to a watercourse. With proper operational procedures, the plant should be capable of improved efficiency.

2. Refuse Disposal

Water pollution problems do not result from the disposal of refuse at the City of Welland dump.

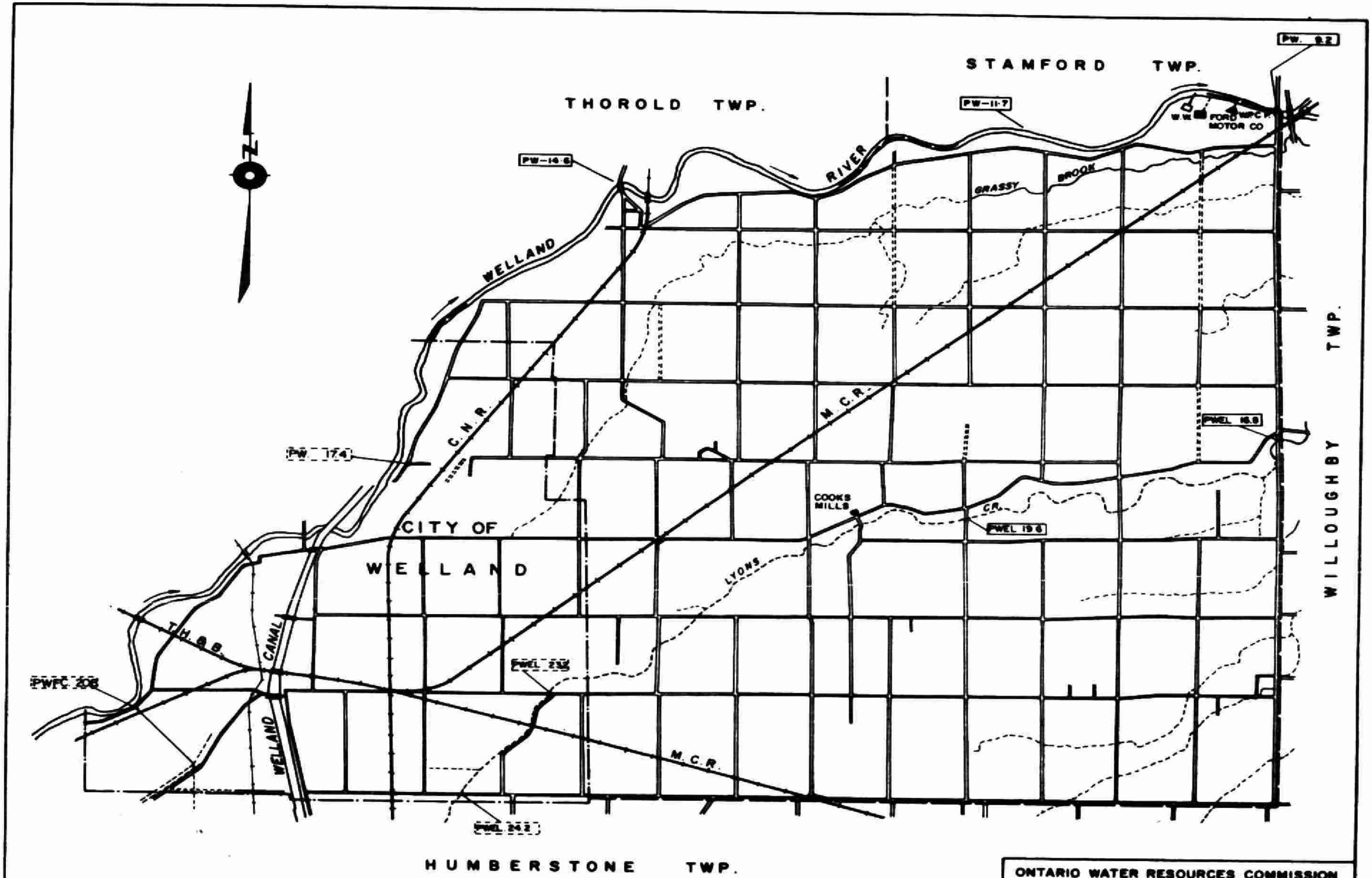
3. Industrial Waste Disposal

There are no serious industrial waste disposal problems in the township. The industrial waste water from the Ford Motor Company Limited contains some suspended material.

4. Surface Water Quality

The results of samples collected from the Welland River and Lyon's Creek are recorded in Table 13-1. Sample locations are shown in Figure 13-1.

Both the Welland River and Lyon's Creek are grossly polluted by industrial wastes and sanitary sewage, originating outside the township.



LEGEND

PWEL-19·6 STREAM SAMPLING POINT SHOWING STREAM AND MILEAGE
▲ WATER POLLUTION CONTROL PLANT
WATER WORKS
—·— CITY LIMITS
—— TOWNSHIP BOUNDARY

ONTARIO WATER RESOURCES COMMISSION

TOWNSHIP OF CROWLAND

FIG. 13—1

SCALE
0 2000 4000 6000 8000'

DRAWN BY: J H	DATE: MAY, 1961
CHECKED BY	DRAWING NO: 61 - 38

5. Future Requirements

The sewage treatment plant serving the Ford Motor Company should be operated in a manner which will produce effluent compatable with the OWRC objectives.

IV CONCLUSIONS

The township is sparsely populated and there are no serious problems at present regarding municipal water supply or sewage disposal.

The Welland River does not constitute a suitable source for domestic water supply. The Ford Motor Company Limited should improve water supply quality by storage prior to treatment or an alternate source of domestic water should be located.

More efficient treatment of sanitary wastes from the Ford Motor Company Limited is required.

TABLE 13-1

SAMPLE RESULTS - TOWNSHIP OF CROWLAND

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenol (ppb)	Iron as Fe (ppm)
PW 9.3	Welland R. at Crowland-Willoughby Line	June/59	2.8	190	4	16	300		
		Feb /61	4.2	220		5	5,000		
		June/62	2.2	196		1.7	14,100	2.0	
		May /63	2.6	200		5.5	730		
		Sept/63	1.2	188	2		3,800		
PW 11.7	Welland R. west opposite side road 2 3/4 miles west of Power Canal	June/59	2.8	200	10	12	300		
		Feb /61	3.7	198		2	500		
		June/62	2.8	292	4.5		8,000		
		May /63	2.0	1242		250	<10	6	3.0
		Sept/63	4.6	240			5,000		
PW 14.6	Welland R. west at bridge, Port Robinson just east of Ship Canal	June/59	1.9	196	16	7	400		
		Feb /61	3.2	194		2	510		
		June/62	1.8	272		34	41,000		
		May /63	3.7	236		21	80,000		
		Sept/63	2.6	220	30		31,000		
PWEL 16.8	Lyon's Cr. at township line, Crowland-Willoughby	June/59	1.3	248	16	15	90		
		Feb /61	6.0	452	42		20		
		June/62	1.8	374		6.5	1,500		2.25
		May /63	1.4	366		2.6	310		
		Sept/63	1.3	284	2		410	2	0.36

TABLE 13-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF CROWLAND

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)		Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Phenol (ppb)	Iron as Fe (ppm)
				Total	Susp.				
PWEL 19.6	Lyon's Cr. at side road ½ mile below Cooks Mill	June/59	1.6	294	4	15	40		
		Feb /61	7.6	312		10	750		2.6
		June/62	5.6	318	29		9,000		
		May /63	2.3	318		2.6	90		
		Sept/63	1.9	290	4		460		0.9
PWEL 23.2	Lyon's Cr. at Ontario road	June/59	7.6	342	8	25	190,000		
		Feb /61	21.0	398		37	5,000		11.8
		June/62	7.0	474	28		247,000	3	4.4
		May /63	2.8	588		110	16,000,000	8	35.0
		Sept/63	6.0	246	13		> 150,000	20	2.64

CHAPTER 14

TOWNSHIP OF HUMBERSTONE

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CHAPTER 14

TOWNSHIP OF HUMBERSTONE

I GENERAL

The Township of Humberstone lies in the south-central portion of the county. Drainage is in the direction of Lake Erie on the south, and the Welland Ship Canal on the west, and Black Creek and Lyon's Creek drain the remainder of the township.

Following the annexation of part of the township to Port Colborne on January 1, 1964, the assessed population is 4,611 persons. The main area of permanent population density is located at Welland Junction which lies mid-way between Welland and Port Colborne. There is considerable cottage development along the shore of Lake Erie. The township is primarily rural in character although there are a few industries.

II WATER SUPPLIES

1. Municipal

Water from the Welland municipal system is supplied to 325 services in the Welland Junction area, including the Glenwood Park subdivision. Further extension of the distribution system in the township is hampered at present, because of water pressure limitations.

The Town of Port Colborne supplies water to 75 services in the township.

2. Private Water Supplies

Eight private water systems supplying lakeshore cottage developments are described below.

Fallon Water Works

This system supplies approximately 23 cottages in the vicinity of Cedar Bay Road. The water is obtained from two drilled wells and is hypochlorinated. The bacteriological quality of the water has been satisfactory and the chemical quality is recorded below.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	226	180	0.62	36	7.5

The water is hard and the concentration of iron exceeds 0.3 ppm.

Pleasant Beach Water Works

This water works serves approximately 50 summer cottages and a trailer park accommodating 20 trailers. The water is obtained from two infiltration wells, and for emergency supply a lake intake is available. The water is hypochlorinated and the bacteriological quality has been satisfactory. The chemical water quality is noted below.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	206	162	0.42	23	7.3

The water is hard and has an iron content in excess of 0.3 ppm.

Sandmere Association Water Works

This water works serves approximately 14 members and obtained supply from infiltration wells on the lakeshore. The water is not chlorinated and adverse bacteriological sample results have been frequently obtained. Chlorination facilities should be installed. The water is hard and the iron content exceeds the recommended 0.3 ppm, as shown by the following analyses.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	272	182	0.38	14	7.5

Silver Bay Association Water Works

Approximately 20 cottages are served by this water works which draws water from both a lake intake and an infiltration well. Since chlorination facilities have been installed the bacteriological quality of the water has been satisfactory. The water is hard as shown by the following analyses.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	210	136	0.28	18	7.6

Silver Bay Water Works

This water works supplies approximately 50 cottages and draws water from three lake intakes. The water treatment consists of chlorination. The bacteriological quality of the treated water is generally satisfactory although on August 14, 1963, an adverse bacteriological examination report was obtained. The chemical quality of the water is satisfactory according to the following analyses.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	120	82	0.22	26	8.4

Silver Sands Water Works

Approximately 50 cottages in the vicinity of Silver Bay Road are served by this water works. Water is obtained from a lake intake and is chlorinated. The bacteriological quality of the treated water has been satisfactory. The chemical quality is satisfactory for domestic consumption, as shown by the following analyses.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	120	82	0.15	25	8.3

Traquair Water Works

This water works supplies 19 summer cottages and two permanent houses. The source of supply is a shallow drilled well. No treatment is provided and several unsatisfactory bacteriological reports have been obtained. Accordingly, chlorination facilities should be installed. The chemical quality of the water is recorded below.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	320	194	0.22	36	7.4

The water is very hard but otherwise of satisfactory chemical quality.

Wyldwood Water Works

This water works supplies approximately 30 consumers. Water is obtained from an infiltration well on the lakeshore and treatment consists of chlorination. The treated water has been bacteriologically satisfactory and except for hardness, the water is of good chemical quality.

Date	Hardness as CaCO	Alkalinity as CaCO	Iron as Fe	Chloride as Cl	pH at Lab
Aug/63	192	138	0.2	20	7.7

John Deere Company Limited - Water Supply

The John Deere Company obtains approximately 1.5 mgd of water from the Welland Ship Canal for cooling and processing purposes. The quality of the raw water is recorded below.

Characteristics	March, 1964
Hardness as $CaCO_3$	136
Alkalinity as $CaCO_3$	102
Iron as Fe	0.24
Chloride as Cl	28
pH at Lab	8.3
Colour in Hazen Units	<5
Turbidity in Silica Units	1.8
M.F. Coliforms	82

3. Potential Additional Water Supplies

(a) Ground Water

The main sources of ground water are bedrock aquifers. Additional supplies of fresh water for domestic needs are available from these aquifers, but are limited because of the proximity of fresh and mineralized water zones. Overburden aquifers occur sporadically in northern parts of the township.

(b) Surface Water

The surface waters which could be considered for water supplies include the Welland Ship Canal and Lake Erie.

4. Future Requirements

The water requirements of the Welland Junction area could be satisfied by an additional feeder main from the City of Welland. Alternately, the township could consider the development of a supply from the ship canal.

Supervision of the multiple private water works serving the lakeshore cottage areas is difficult. A municipal water works would be preferable as the standard of treatment could be readily maintained.

III WATER POLLUTION

1. Sewage Disposal

Private septic tanks and tile bed systems are generally used. The watercourses in the vicinity of Welland Junction contain tile bed leachate, as shown by the analyses in Table 14-1. Minor problems with sewage disposal have also been encountered in other parts of the township, including the Community of Gasline.

The Bridgeview Public School at Welland Junction is served with a pre-fabricated activated sludge sewage treatment plant, with a design capacity of 5,000 US gpd. Treatment consists of comminution, aeration, and final settling. The effluent is disinfected with a chlorine solution, and discharged to a ditch tributary to the ship canal. The effluent characteristics are indicated by seven grab samples collected during 1962-63.

	5-Day BOD ppm	Suspended Solids ppm
Average	94	109
Minimum	17	29
Maximum	225	252

The effluent quality considerably exceeds the recommended objectives. Operation should be improved to provide a satisfactory effluent.

2. Refuse Disposal

The refuse disposal site is located near a watercourse which drains to Black Creek. Improper maintenance of the open dump could lead to water pollution.

3. Industrial Waste Disposal

A subsurface disposal system handles sanitary and industrial wastes from the John Deere Company Limited.

The C. Visser poultry killing establishment is served with a septic tank and tile bed system for the disposal of process wastes.

4. Surface Water Quality

Sample results are contained in Table 14-1 and sampling locations are shown in Figure 14-1.

Considerable quantities of hazardous polluting materials are discharged to the Welland Ship Canal, the various drainage ditches and a section of Lyon's Creek in the Welland Junction area. The water quality in the canal at the Welland Junction bridge has been generally satisfactory except for one sample which showed an excessive coliform density.

Some pollution has been evident in the surface drainage ditches discharging to Lake Erie at the southern ends of Snider Road, Weaver Road and Cedar Bay Road. These problem areas should be examined more closely.

5. Future Requirements

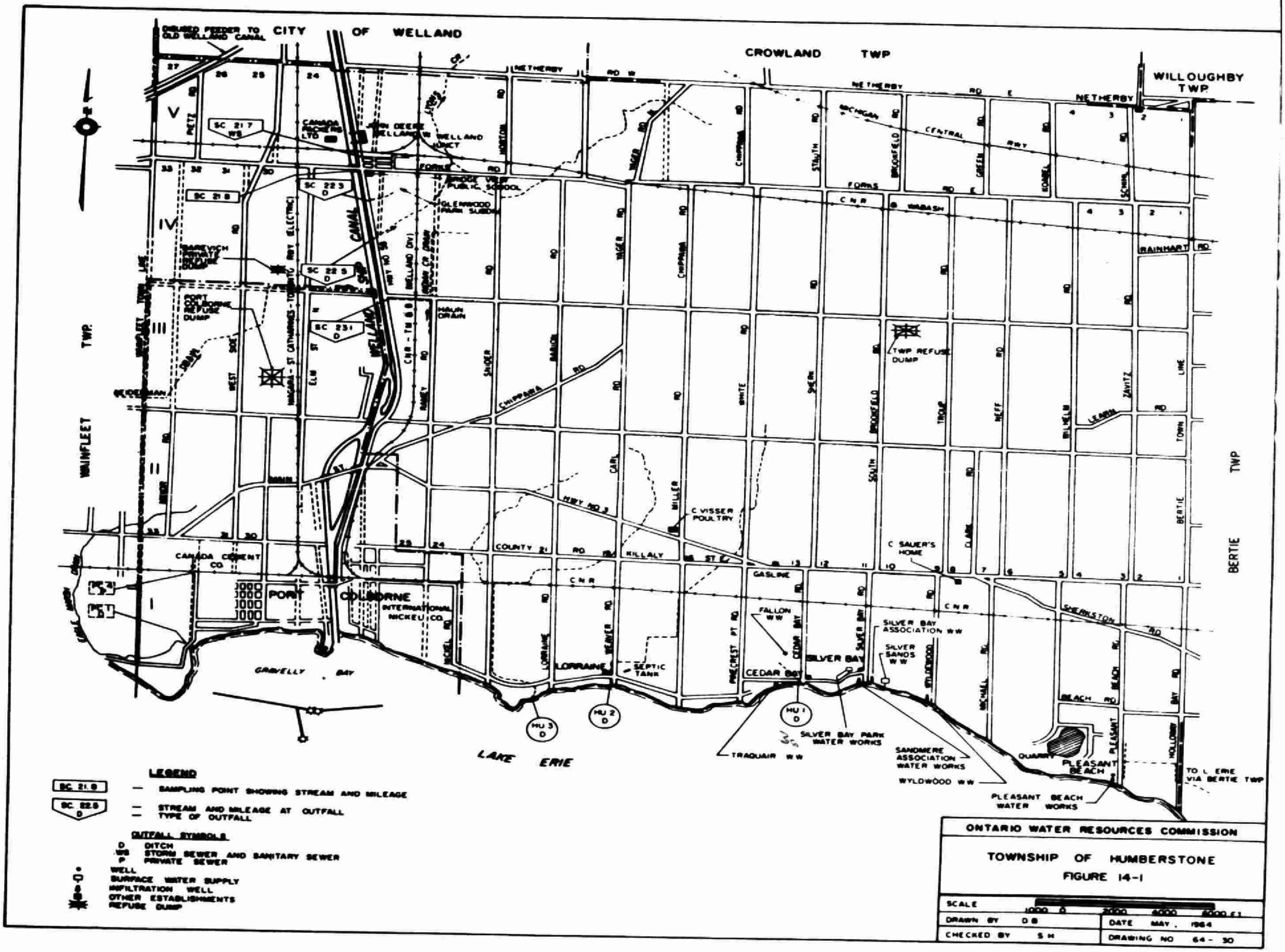
Sewage disposal problems in the Glenwood Park subdivision could best be resolved by the construction of municipal sewage works.

IV CONCLUSIONS

As residential development continues at Welland Junction, improvements to the existing water supply system will be required. An additional or larger diameter supply main from the City of Welland should be provided. Alternately, a separate water treatment plant supplied from the ship canal could be considered.

The ditches, storm sewers, and Lyon's Creek in the vicinity of Welland Junction and Glenwood Park are polluted and constitute a public health hazard. A municipal sewerage system should be installed.

Improved treatment at the Bridgeview Public School sewage treatment plant is necessary.



LEGEND

SC 21.8	—	SAMPLING POINT SHOWING STREAM AND MILEAGE
SC 22.5 D	—	STREAM AND MILEAGE AT OUTFALL
	—	TYPE OF OUTFALL

OUTFALL SYMBOLS

D	DITCH
WS	STORM SEWER AND SANITARY SEWER
P	PRIVATE SEWER
•	WELL
	SURFACE WATER SUPPLY
	INFILTRATION WELL
	OTHER ESTABLISHMENTS
	REFUSE DUMP

ONTARIO WATER RESOURCES COMMISSION

TOWNSHIP OF HUMBERSTONE

FIGURE 14-1

SCALE	1000 0 2000 4000 6000 FT		
DRAWN BY	D B	DATE	MAY, 1964
CHECKED BY	S H	DRAWING NO	64-30

TABLE 14-1

SAMPLE RESULTS - TOWNSHIP OF HUMBERSTONE

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)
SC 21.5	Welland Canal at Welland Junction bridge	June/59	1.4	124				50	
		Aug /60	1.3				4.0	1,470	
		Jan /61	2.0	180			11.0	111	
		Jan /62	1.1	200			2.3	390	
		Nov /63	1.8	234	7	227		650	
SC 21.7 WS	Huron Street storm sewer	June/59	290	526	30	496		12,000,000	
		May /61	42.0	644	50	594		700	
		Mar /64	49.0	702	43	659		128,000	
SC 22.3D	Ditch south of Glenwood Parkway	Mar /64	13.0	632	58	574		242,000	
SC 22.5 D	Lyon's Cr. discharge to Welland Ship Canal	May /61	3.2	268	8	260		0	1.12
		Mar /64	7.2	524	21	503		71,000	
SC 23.1 D	Haun Drain to Welland Ship Canal	May /61	4.8	566	46	520		247	1.32
HU 1-D	Drainage ditch to Lake Erie Cedar Bay area	May /61	4.0	230	22	208		115	

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TABLE 14-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF HUMBERSTONE

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)
HU 2-D	Drainage ditch	July/59	6.0	342	18	329		10	
	to Lake Erie	May /61	16.0	314	40	274		60	
	Weaver Road								
HU 3-D	Drainage ditch	July/59	9.0	342	16	326		10	
	to Lake Erie	May /61	4.0	376	36	340		237	
	Snider Road								

CHAPTER 15

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CHAPTER 15

TOWNSHIP OF PELHAM

I GENERAL

The Township of Pelham is situated in the north-west corner of the county. The Welland River forms the southern boundary and generally receives drainage from the area south of No. 20 highway. The area north of the highway drains to Lake Ontario through Twelve Mile, Fifteen Mile and Sixteen Mile creeks.

The population of the township is 4,796 persons. The areas of population density include the Police Village of Fenwick, the communities of Ridgeville and Pelham Centre. The area on the west and the south of the Village of Fonthill is also developed.

The economy of the township is primarily agricultural and fruit farming constitutes a leading activity. Some sand and gravel deposits are exploited.

II WATER SUPPLIES

1. Municipal

Water from the City of Welland system is supplied to an estimated 390 persons in the areas located south and west of Fonthill. There are 114 flat rate services and two metered services. The distribution network comprises 2.97 miles of mains varying in diameter from 8 to 12 inches, and 12 hydrants. Pressure is maintained in the system by a pump which draws from a 65,000 gallon ground level reservoir.

In 1963, the period of maximum water consumption was recorded between July 5 and July 14 when 1,062,700 gallons of water were used. This represents a maximum daily per capita consumption of 305 gallons. The high consumption is probably due to sprinkling. On July 12, 1960, the per capita consumption was recorded at 354 gallons.

2. Private Water Supplies

The Moyer's Sand and Gravel Limited employs a drilled well with a 10-inch casing for gravel washing purposes. The well pump has a capacity of 800 gpm.

Most of the residences in the township are served by private wells. Contamination is present in many of the dug wells but this can be attributed frequently to faulty construction. The water quality of samples from two wells in the township is recorded below.

	Date Sampled	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.	Coliforms per 100 ml
1.	Feb./64	260	120	0.18	47	7.8	0
2.	Feb./64	314	74	0.75	5	8.0	0

1. Pelham Centre private residence, dug well
2. Fenwick school, drilled well

Both wells contained hard water. The concentration of iron in the drilled well water was above the recommended maximum of 0.3 ppm.

3. Potential Additional Supplies

(a) Ground Water

Ground-water conditions in the overburden and the bedrock in the township are generally favourable for the development of additional ground-water supplies. Recent test drilling located sites where wells capable of yielding up to 200 gpm of satisfactory quality water could be developed in sand and gravel deposits. The quantities of water available from the bedrock are variable, but the quality is generally marked by excessive hardness and high iron content.

(b) Surface Water

At present the Welland River is not a desirable or sufficient source for municipal supply.

4. Future Requirements

The residents in the general area west of Fonthill near the communities of Ridgeville and Pelham Centre have already indicated interest in a municipal water system. The proposed project has been deferred, but the township has purchased the site where a suitable ground water supply was located.

Considering an average growth rate, the population of Fenwick will be 1,000 in the year 1980. The need for a municipal water supply will become more evident as the village continues to develop.

III WATER POLLUTION

1. Sewage Disposal

Since 1955, the township has had a building by-law which incorporates the construction of septic tank tile bed systems and regulates the minimum size of building lots at 15,000 square feet. The soils in the township are generally of a sandy nature, and this favours the operation of tile bed systems. Although there have been some problems with sewage disposal in Fenwick, these have been largely corrected.

The Welland-Crowland Airport is served with a septic tank which overflows to the Welland River. This system was installed during the Second World War and served the barracks and airport building. Limited use is made of these facilities. A tile bed should be installed to receive the septic tank effluent.

2. Refuse Disposal

The township operates an open dump on four acres of land adjacent to Fonthill Sand and Gravel Limited. Four or five times a year the accumulated garbage is covered with earth. Surface water pollution problems have not been encountered.

3. Industrial Waste Disposal

An abandoned gravel pit west of Effingham St. and north of No. 200 Highway is used by the General Tire and Rubber Company for solid waste disposal. There have not been any associated pollution problems.

The Tregunno Niagara Farms Limited canning factory operates seasonal retention lagoons for waste water disposal. In the past, stream pollution has resulted from breaks in the lagoon dikes and from forcemain leakage.

The P. Krusell poultry killing establishment is served by a septic tank which overflows to a farm ditch.

4. Surface Water Quality

The results of samples collected from surface waters in the township are included in Table 15-1, and the sampling points are located in Figure 15-1. The sections of Fifteen Mile Creek and Sixteen Mile Creek within the township boundaries are generally dry during the summer months, and samples obtained during September, 1961, showed that water quality was satisfactory.

The pollution of Twelve Mile Creek at sampling point TES 13.6 on October 5, 1961, can be attributed to unsatisfactory waste disposal practices at the upstream cannery.

On the Welland River at sampling point PW 21.2 the water quality is generally unsatisfactory. This may be caused by a back water effect extending from below the City of Welland. The occasional high BOD and coliform count at sampling point PW 27.0 may be attributed to either run-off from agricultural lands or wastes from the community of Wellandport.

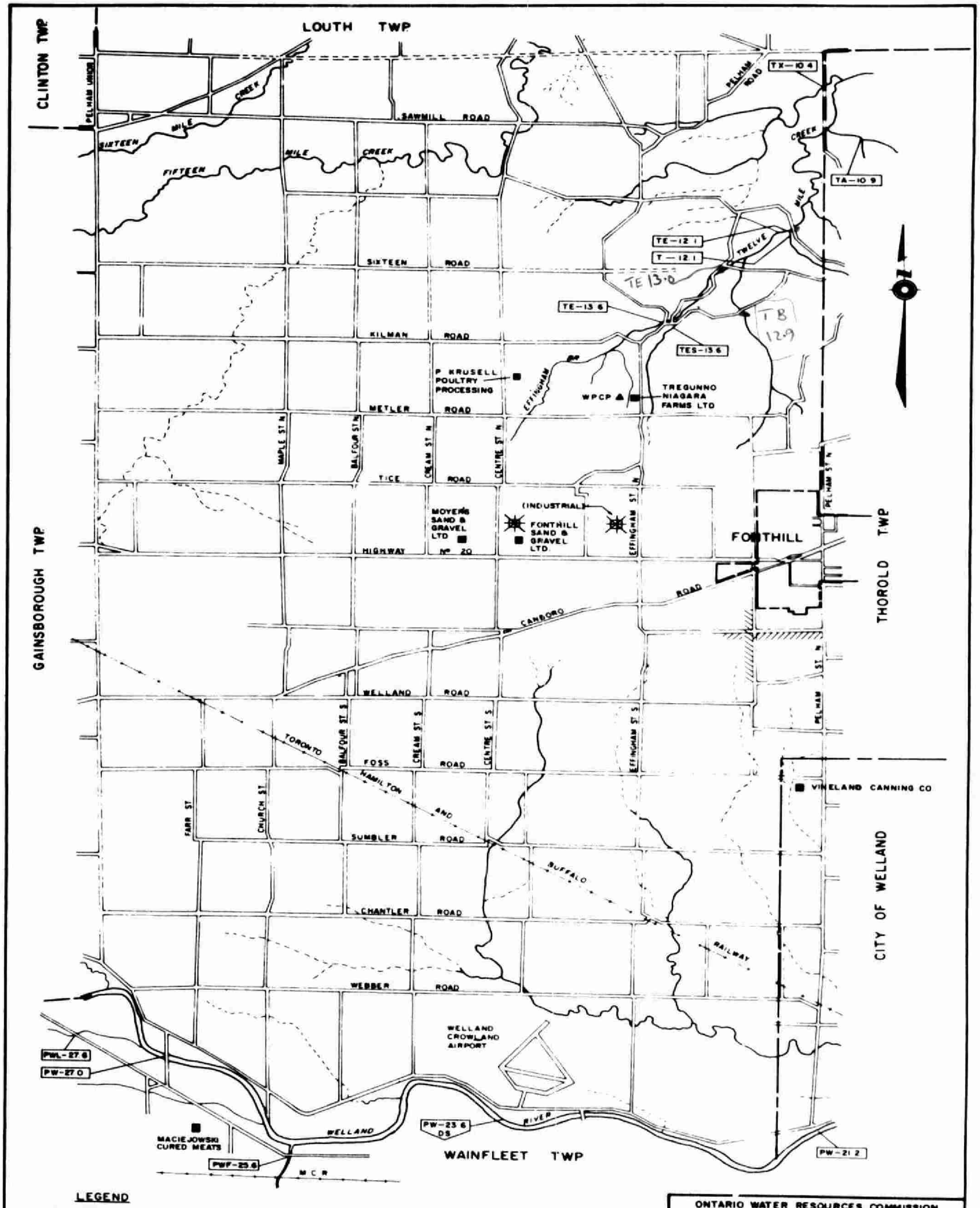
5. Future Requirements

There are no plans at present for the construction of municipal sewage works in the township. The future needs in this regard will be influenced by the population density and the development of water works systems in the township.

CONCLUSIONS

Development of municipal water works systems to supply the communities of Ridgeville, Pelham Centre and the Police Village of Fenwick would be desirable. Ground water resources should be utilized where possible.

The management of the Tregunno Niagara Farms Limited should ensure that the waste disposal facilities are operated efficiently. Improved waste disposal facilities are required at the P. Krusell poultry killing establishment. A tile bed should be constructed to serve the Welland-Crowland Airport.



LEGEND

TE-12.1 STREAM SAMPLING POINT

PW-23.6 DS OUTFALL SAMPLING POINT
TYPE OF OUTFALL
D – DITCH
S – SANITARY SEWAGE

▲ WPCP

■ OTHER ESTABLISHMENTS

////////// WATER AREA

✳ REFUSE DISPOSAL SITE

ONTARIO WATER RESOURCES COMMISSION

TOWNSHIP OF PELHAM

FIG. 15-1

SCALE 0 1/4 1/2 MILE	
DRAWN BY R.W.	DATE JUNE, 1964
CHECKED BY R.N.D.	DRAWING Nº 64-55

TABLE 15-1

SAMPLE RESULTS - TOWNSHIP OF PELHAM

TWELVE MILE CREEK

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity	M.F. Coliform Count per 100 ml.
				Total	Susp.	Diss.		
TX 10.4	West branch of Twelve Mile Creek at Pelham-Thorold Line	June 16/59	2.6	480			5	10,000
		May 16/61	2.1	420			3	55
		Oct. 5/61	1.5	528			2	310
		June 20/62	-	426			4	1,380
TA 10.9	Aerial beacon branch of Twelve Mile Creek at Pelham-Thorold Line	June 16/59	1.3	360			7	10,000
		May 16/61	2.2	400			7	284
		Oct. 5/61	1.8	348			1	99
		June 20/62	-	408			27	3,600
TE 12.1	Effingham branch of Twelve Mile Creek just above junction at St. John's W-Allanburg Rd.	June 16/59	1.8	360			4	10,000
		May 16/61	2.2	330			3	193
		Oct. 5/61	2.2	326			1	109
		June 20/62	-	320			3.8	12,000
T 12.1	Twelve Mile Creek just above junction with Effingham branch	June 16/59	1.7	346			9	20,000
		May 16/61	2.3	356			5	131
		Oct. 5/61	2.3	396			1	22
		June 20/62	-	382			3.8	970

TABLE 15-1 (cont.)

SAMPLE RESULTS - TOWNSHIP OF PELHAM

TWELVE MILE CREEK (cont.)

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity	M.F. Coliform Count per 100 ml.
TE 13.6	Effingham branch at Twelve Mile Creek at Pelham Road	June 16/59	1.5	354			13	10,000
		May 16/61	2.0	330			3	72
		Aug. 10/61	3.6	294				
		Oct. 5/61	1.7	326			2	300
		June 20/62		326			8	59,000
		Jan. 29/63	3.0	322			5	280
TES 13.6	South tributary of Effingham branch just above junction	June 16/59	1.6	686			13	20,000
		May 16/61	1.5	346			1	3
		Oct. 5/61		842			14	4,000
		June 20/62		360			1.4	198

TABLE 15-1 (cont.)

SAMPLE RESULTS - TOWNSHIP OF PELHAM

WELLAND RIVER

Sampling Point No.	Location	Date	5-Day BOD (ppm)	Solids (ppm) Total	Solids (ppm) Susp.	Solids (ppm) Diss.	Turbidity	M.F. Coliform Count per 100 ml.
PW 21.2	Welland River West opposite Pelham Twp.-Welland Line	June/59	14.0	334	64		87	50,000
		Feb./61	5.6	264			2	7,700
		June/62	2.8	300			45	39,000
		May/63	4.4	396			65	37,000
		Sept./63	2.6	342	54			6,000
PW 27.0	Welland River just opposite junction of #3A and #57 highways	June/59	3.2	286	38		58	71
		Feb./61	4.0	342			5	2,500
		June/62	1.8	328			45	10,000
		May/63	2.5	348			45	1,010
		Sept./63	3.0	346	20			900

CHAPTER 16

TOWNSHIP OF THOROLD

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CHAPTER 16

TOWNSHIP OF THOROLD

I GENERAL

The Township of Thorold is situated in the north central section of the County of Welland. Drainage is provided mainly by the Welland River, the Welland Ship Canal and Twelve Mile Creek. The second Welland Canal industrial waste drain which is tributary to Twelve Mile Creek is a significant artificial drainage channel. Water diverted from the Welland Ship Canal at Allanburg for power generating purposes and Beaver Dam Creek forms Lake Gibson upstream from the HEPC generating station. The City of St. Catharines water works supply canal is also located in the township.

The population of the township is 7,055 persons. The main concentrations of population are the communities of Thorold South, Allanburg and Port Robinson. While the character of the area remains predominantly rural, the township has a significant number of large industries.

II WATER SUPPLIES

1. Municipal

(a) Sources

The township owns and operates a water works system which obtains water from the Welland Ship Canal to supply the Thorold South area. Portions of the township are served with water from the municipal systems of the City of St. Catharines, the City of Welland, the City of Niagara Falls, and the Town of Thorold.

(b) Treatment Works

The water works provides the following treatment; alum coagulation, anthrafilt pressure-filtration and chlorination. Turbidity removal by alum coagulation is inefficient because of inadequate settling facilities. The filtration capacity of the plant is 0.47 mgd.

(c) Water Consumption

The average daily water consumption is approximately 0.25 mgd. The maximum daily demand in 1963 was 0.33 mgd. The corresponding estimated per capita consumption is 166 gpcpd.

(d) Water Quality

A total of 149 bacteriological samples were collected in 1963, and all samples indicated satisfactory treated water quality.

A summary of the chemical analyses performed since 1959 on three samples of raw water and eight samples of treated water is shown below.

	Raw Water			Treated Water		
Characteristic	Avg.	Min.	Max.	Avg.	Min.	Max.
Hardness as $CaCO_3$	131	126	136	132	114	144
Alkalinity as $CaCO_3$	101	100	104	96	74	104
Iron as Fe	0.88	0.43	1.6	0.2	0	0.65
Chloride as Cl	22	18	26	24	17	27
pH at Lab.	7.9	7.6	8.1	7.8	7.1	8.1
Turbidity in Silica Units	18	12.5	24	7	0.7	26
Free Ammonia	0.14	0.08	0.2	0.15	0.13	0.18
Total Kjeldahl	0.32	0.26	0.38	0.22	0.2	0.24
Colour in Hazen Units	<5			<5		

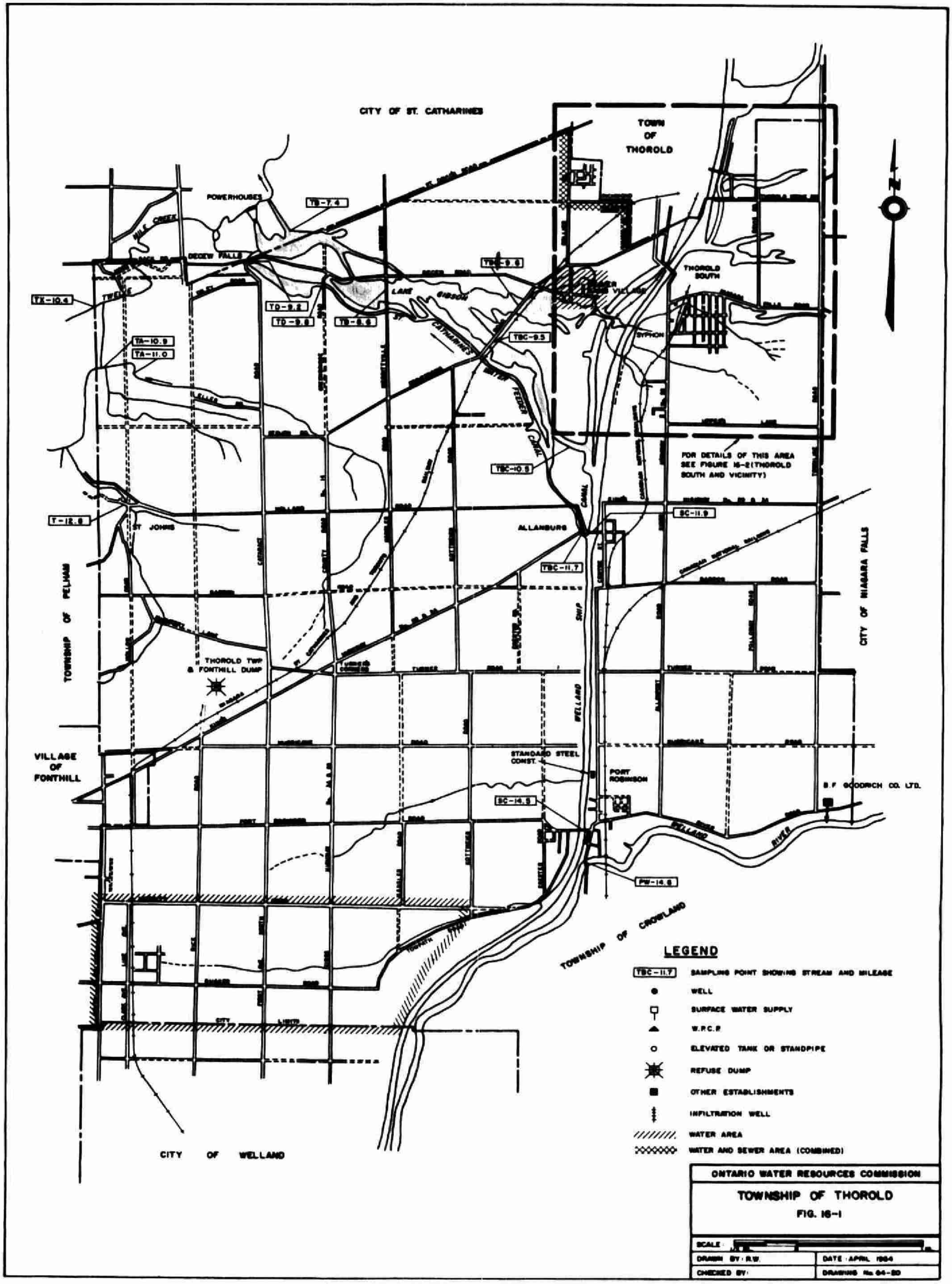
The water is moderately hard, and the fluctuating iron content sometimes exceeds the objective of 0.3 ppm. The turbidity of the treated water should not exceed five units. This degree of treatment is not always attained. The free ammonia content indicates an organically enriched water.

(e) Distribution

The township system generally serves the area known as Thorold South and Windle Village. This system includes 346 domestic, 6 commercial, 4 industrial and 2 institutional services.

The City of Welland supplies approximately 187 services in the south west portion of the township. The City of St. Catharines system serves approximately 56 homes in Beaver Dams Village. The Town of Thorold supplies water to approximately 249 services in the township. The B.F. Goodrich Chemicals Limited receives water for sanitary and limited industrial use from the City of Niagara Falls.

The areas served with water are indicated in Figure 16-1 and 16-2.



LEGEND

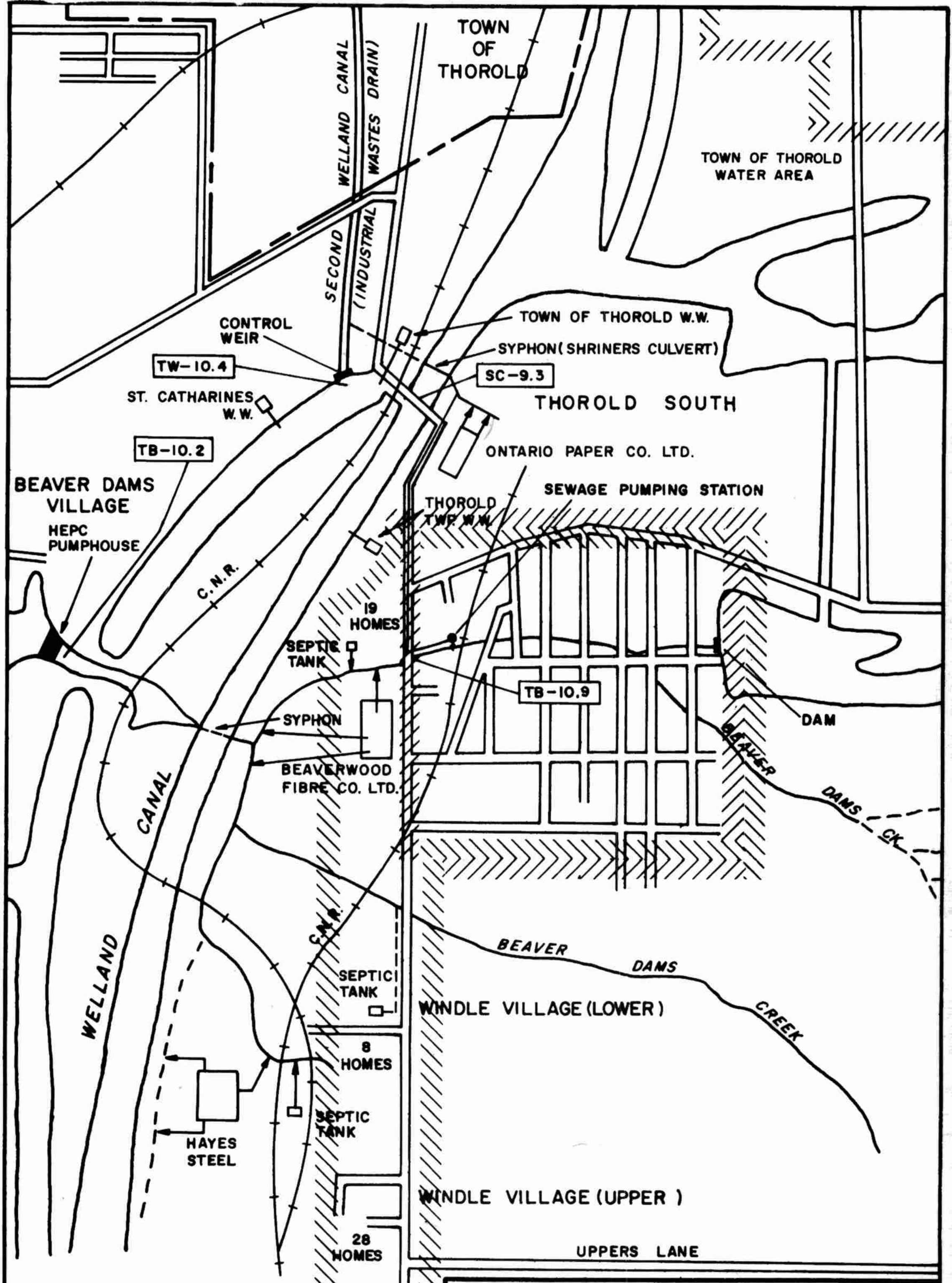
TBC-11.7	SAMPLING POINT SHOWING STREAM AND MILEAGE
●	WELL
⍡	SURFACE WATER SUPPLY
▲	W.P.C.P
○	ELEVATED TANK OR STANDPIPE
✸	REFUSE DUMP
■	OTHER ESTABLISHMENTS
‡	INFILTRATION WELL
////////.	WATER AREA
◇◇◇◇◇◇	WATER AND SEWER AREA (COMBINED)

ONTARIO WATER RESOURCES COMMISSION

TOWNSHIP OF THOROLD

FIG. 16-1

SCALE	
DRAWN BY: R.W.	DATE: APRIL 1964
CHECKED BY:	DRAWING No. 64-20



LEGEND

TW-10.4 STREAM SAMPLING POINT
W.W. WATERWORKS
▧ SEWER AREA
▨ WATER AREA

ONTARIO WATER RESOURCES COMMISSION

TWP. OF THOROLD,
THOROLD SOUTH
AND VICINITY
FIG. 16-2

SCALE: 1/2 0 1 ML.

DRAWN BY: R.W.
DATE: MAY 1964
CHECKED BY:
DRAWING No. 64-29

2. Private Water Supplies

There are four industrial water supplies, and the details of these systems are outlined in the following table.

Industry	Source	Treatment	Pumpage mgd	Use
Beaver Wood Fibre Company Ltd.	Welland Ship Canal	nil	5.0	Processing
Exolon Co. Ltd.	Welland Ship Canal	nil	0.9	Cooling
Hayes Steel Products Ltd.	Welland Ship Canal	filt. & chl.	0.08	Domestic & Industrial
Ontario Paper Company Ltd.	Welland Ship Canal	chlorination	26.3	Processing

The water quality is comparable to that obtained by the township water works.

The rural areas and Port Robinson are served by private dug wells, cisterns and drilled wells.

3. Potential Additional Water Supplies

(a) Ground Water

Additional ground-water supplies are available in the township for domestic needs. Limestones and dolomites of the Lockport and Guelph formations underlie the township and are good sources of water for domestic supplies and small industrial or municipal supplies. Water-bearing sands and gravels are present in the overburden in the southwestern part of the township and could be developed further.

(b) Surface Water

The only source of surface water which is suitable for a municipal water supply is the Welland Ship Canal.

4. Future Requirements

The Township of Thorold system serves approximately 1,500 persons. By 1980 this may increase to 2,300 persons and overtax the present facilities.

Increased filtration capacity will be necessary. In addition, improved coagulation and settling facilities would be advisable.

A survey by the Welland and District Health Unit of the private wells in the Port Robinson area revealed that a municipal supply would be desirable. An engineering report indicated that this project would not be economically feasible at the present time. However, the township should proceed with development of a system as soon as finances permit.

III WATER POLLUTION

1. Sewage Disposal

(a) Existing Conditions

A sanitary sewer system and sewage pumping station serves Thorold South. The sewage is pumped to the east end of Shriner's culvert where it combines with industrial wastes from the Ontario Paper Company Ltd.

Seven single family dwellings and six duplex houses owned by the Beaver Wood Fibre Company Ltd. are served by a septic tank which overflows to Beaver Dams Creek. Windle Village comprises eight houses in the lower village and twenty-eight houses in the upper village. The village is served by two septic tanks which overflow to ditches tributary to Beaver Dams Creek.

Sewers in the area west of the Town of Thorold discharge to the town sewerage system.

In the remainder of the township, sewage disposal is achieved by septic tank systems or privies. Problems have been encountered with malfunctioning systems, but usually these have been corrected.

The following sample analyses indicate the degree of sewage pollution.

Location	Date	5-Day BOD	Solids Total	Solids Susp.	Solids Diss.	M.F. Coliforms per 100 ml.
Thorold South, sewage pumping station	June/59 May/61	250 8.0	726 234	100 28	626 206	64,000,000
Beaver Wood houses, septic tank effluent		1970	3286	2846	440	21,000,000
Beaver Dams Village, ditch		500	2512	1800	712	91,000,000
Lower Windle Village, septic tank effluent		230	834	422	412	7,300,000
Upper Windle Village, septic tank effluent		40	414	43	371	850,000

(b) Proposed Sewage Works

The township has agreed to share in the cost of the Town of Thorold trunk sewer which leads to the St. Catharines sewerage system. The stage of the project involving the Welland Ship Canal crossing has been delayed because of the proposed twinning of the locks by the St. Lawrence Seaway Authority. It is expected that the Upper and Lower Windle Village area will connect to the Thorold South sewer system. The Beaver Wood Fibre Company Limited homes should also be provided with municipal sewers.

2. Refuse Disposal

The refuse dump which is shared by the Township and Fonthill overlooks a deep ravine, and some of the material spills into the valley below. Drainage from this area is tributary to one of the upper branches of Twelve Mile Creek. The watercourse should be protected from the possible escape of polluting leachate.

3. Industrial Waste Disposal

Wastes highly charged with BOD and suspended solids are being discharged by the Beaver Wood Fibre Company Limited to Beaver Dams Creek. The plant sanitary sewage is combined with the industrial waste water. The waste water from the Hayes Steel Products Limited, which contains septic tank effluent and varying concentrations of iron and oil, is also discharged to Beaver Dams Creek. This part of the creek is tributary to Lake Gibson by means of a siphon under the ship canal and a lift station operated by the HEPC.

B. F. Goodrich Chemicals Limited discharges partially treated wastes to the Welland River.

The Ontario Paper Company Limited discharges paper mill wastes containing high concentrations of BOD and suspended solids to the Second Welland Canal industrial waste drain.

Wastes from the Exolon Company Limited, the Nichols Chemical Company Limited and the Standard Steel Construction Division of the United Steel Corporation Limited generally do not contribute to serious pollution.

Four slaughter houses are served with septic tank and tile bed systems which operate satisfactorily.

4. Surface Water Quality

The analytical results of surface water samples are listed in Table 16-1. Refer to Figures 16-1 and 16-2 for sampling point locations.

The BOD of the water in Lake Gibson is satisfactory even though considerable industrial and sanitary wastes are discharged to the waterway. The concentration of coliforms in the lake water is at times excessive, indicative of recent pollution.

The adverse samples obtained from the headwaters of Twelve Mile Creek may be due to pollution of an agricultural nature.

The water quality in the Welland Ship Canal is generally satisfactory. However, at point SC 9.5 one sample contained high BOD, and the coliform concentration in another sample was above the objective.

At sampling point PW 14.6 on the Welland River an excessive concentration of coliform organisms was found in three of five samples. This sampling point is downstream from the City of Welland raw sewage discharges.

5. Future Requirements

The sewage requirements of the Thorold South area could be satisfied for some time by the available sewer leading to the Port Weller sewage treatment plant in St. Catharines. Elsewhere in the township the domestic sewage disposal problems are minor. However, sewerage works should be considered whenever a municipal water supply is provided at Port Robinson.

IV CONCLUSIONS

Planning should include the provision of a water supply system for the community of Port Robinson. At most times the Thorold South Water Works supplies a suitable quality water. Improved treatment could be achieved if more adequate coagulation and settling facilities were available. Additional filtration capacity may be required before 1980.

Control of industrial waste discharges requires immediate attention. The Thorold South sanitary sewer system should be connected to the trunk sewer serving the Town of Thorold as soon as it is feasible. Sewers should also be extended to serve Windle Village and the Beaver Wood Company houses.

TABLE 16-1

SAMPLE RESULTS - TOWNSHIP OF THOROLD

TWELVE MILE CREEK AND GIBSON LAKE SYSTEM

Sampling Point No.	Location	Date	5-Day BOD	Solids			Turbidity	M.F. Coliforms per 100 ml
				Total	Susp.	Diss.		
TX 10.4	Twelve Mile Creek	June/59	2.6	480			5	10,000
	(west branch) at	Oct./61	1.5	528			2	310
	Thorold-Pelham boundary	June/62	-	426				1,380
TA 10.9	Twelve Mile Creek	June/59	1.3	360			7	10,000
	(aerial beacon branch) at	Oct./61	1.8	348			1	99
	Thorold-Pelham boundary	June/62	-	408			27	3,600
T 12.8	Twelve Mile Creek	June/59	1.9	336			4	20,000
	just below St. Johns W.	Oct./61	1.6	386			1	129
		June/62	-	372			4	1,500
TD 9.2	Twelve Mile Creek	June/59	6.0	242			16	10,000
	(De Cew Falls branch)	Oct./61	1.5	222			6	10
	from De Cew Road	June/62	-	196			3.5	4,300
	bridge	Jan./63	3.4	208			5.0	160
TB 7.4	Gibson Lake at power	June/62	-	228			<4	830
	headworks	Jan./63	3.2	210			5	340

TABLE 16-1 (cont.)

SAMPLE RESULTS - TOWNSHIP OF THOROLD

TWELVE MILE CREEK AND LAKE GIBSON SYSTEM (cont.)

Sampling Point No.	Location	Date	5-Day BOD	Solids Total	Solids Susp.	Solids Diss.	Turbidity	M.F. Coliforms per 100 ml.
TBC 11.7	Ship canal diversion at Highway No. 20	Oct./61	1.4	244			7	1,060
		June/62	2.2	224			3.8	78
		Jan./63	-	234			12.5	9,000
TB 8.6	Lake Gibson at Sanitorium Road	Oct./61	1.6	242			5	1,120
		June/62	-	-			-	530
		Jan./63	-	230			9.5	4,000
TB 10.9	Beaver Dams Creek Highway No. 58	Oct./61	80	488			22	6,000
		June/62	-	264			5.5	11,100
		Jan./63	58	298	30	268		1,320

WELLAND SHIP CANAL

Sampling Point No.	Location	Date	5-Day BOD	Solids Total	Solids Susp.	Solids Diss.	Turbidity	M.F. Coliforms per 100 ml.
SC 9.5	Welland Ship Canal at Thorold South bridge	June/59	4.4	158	26	132		1,000
		Aug./60	1.2				10	240
		Jan./61	3.0	176			9	60
		June/62	0.9	216			13.5	8,000
		Nov./63	1.9	224	13	211		470

TABLE 16-1 (cont.)

SAMPLE RESULTS - TOWNSHIP OF THOROLD

WELLAND SHIP CANAL (cont.)

Sampling Point No.	Location	Date	5-Day BOD	Solids Total	Solids Susp.	Solids Diss.	Turbidity	M.F. Coliforms per 100 ml
SC 11.9	Welland Ship Canal at Allanburg bridge	June/59	2.6	146	22	124		120
		Aug./60	1.6				11	390
		Jan./61	1.6	176			12	190
		June/62	0.7	194			7.5	270
		Nov./63	1.8	230	10	220		510
SC 14.5	Welland Ship Canal at Port Robinson bridge	June/59	1.2	148			8	70
		Aug./60	1.2				10	340
		Jan./61	2.2	174			10	170
		June/62	0.6	206			7.5	800
		Nov./63	2.2	208	6	202		460

WELLAND RIVER

Sampling Point No.	Location	Date	5-Day BOD	Solids Total	Solids Susp.	Solids Diss.	Turbidity	M.F. Coliforms per 100 ml
PW 14.6	Welland River (west) at Port Robinson bridge	June/59	1.9	196	16	180	7	400
		Feb./61	3.2	194			2	510
		June/62	1.8	272			34	41,000
		May/63	3.7	236			21	80,000
		Sept./63	2.6	220	30			31,000

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CHAPTER 17

TOWNSHIP OF WAINFLEET

I GENERAL

The Township of Wainfleet is situated between the Welland River and Lake Erie in the south-west portion of the county. The Welland River and its tributaries provide drainage for most parts. Lake Erie drains a narrow section which abuts the lake. The eastern part of the township drains to the Welland Ship Canal. The township is bisected from west to east by the disused Feeder Canal. Local drainage channels are conveyed under the canal by siphons.

The assessed population of the township is 4,875 persons. While the township is primarily rural, a number of summer cottage developments exist along the lakeshore and several hamlets are located along Highway No. 3.

II WATER SUPPLIES

1. Municipal

There are no municipal water systems.

2. Private Water Supplies

Seven private water supplies serving lakefront communities are described below.

Bowen, Long Beach Water Works

Water is drawn through five lake intakes by four pumps to supply approximately 250 consumers in the Walnut Hill subdivision. Treatment consists of chlorination and pressure sand filtration.

The bacteriological water quality is generally satisfactory.

The water is moderately hard but otherwise chemically satisfactory.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.
July, 1962	136	96	0.13	26	8.5

Lakewood on Erie - Crippled Children's Camp Water Works

The water works is operated from June to September and serves approximately 60 children and 40 staff members. The swimming pool requires about 1,000 gpd and the total water demand for the camp is estimated at 20,000 gpd. The water is derived from three sources: an infiltration well, a lake intake and a drilled well. The drilled well constitutes the main source. Treatment consists of aeration, settling chlorination and pressure filtration.

The bacteriological water quality has been satisfactory.

Except for the hardness, the drilled well water is chemically satisfactory.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.
Aug., 1963	224	166	0.15	14	7.7

Long Beach Park Water Works - Niagara Peninsula Conservation Authority

The water works is operated during the summer months and provides water for domestic use. The supply is obtained from a lake intake and is chlorinated.

The samples collected for bacteriological examination have been satisfactory.

The water is hard but satisfactory.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.
July, 1962	140	102	0.0	25	8.3

Neff Water Works - Morgan's Point

The water works serves a dance hall, a restaurant and eight cottages. The water is obtained from a drilled well and is chlorinated. The bacteriological quality has been satisfactory.

The water is hard, and the iron content exceeds the recommended maximum limit of 0.3 ppm.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.
Aug., 1963	228	154	0.72	24	7.6

Mansell Water Works - Willow Bay

This water works supplies six cottages at Willow Bay. Water is obtained from an infiltration well on the shore of Lake Erie. The water is chlorinated, and bacteriological sample results have been satisfactory. The water is hard, and the chemical quality is recorded below.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.
Aug., 1963	310	204	0.08	17	7.6

Wayne Park Water Works

The water works serves approximately 42 customers in the Wayne Park Beach subdivision area. Water is obtained from five infiltration wells located on the Lake Erie beach. Inadequate chlorination practices have resulted in unsatisfactory bacteriological quality. The works are in need of repair.

The chemical quality of the water is recorded below.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.
Aug., 1963	246	162	0.22	20	7.6

Willow Bay Water Works

The water works serves a grocery store, two permanent residences and three cottages, and the water is obtained from an infiltration well on the shore of Lake Erie. Chlorination practices have been satisfactory.

The chemical water quality is indicated.

Date	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe	Chloride as Cl.	pH at Lab.
July, 1962	404	370	0.0	15	7.1

3. Potential Additional Supplies

(a) Ground Water

Additional ground-water supplies are available in the township for domestic needs. In the central and northern parts of the township, deep overburden aquifers can be developed further. Bedrock aquifers in these areas produce some mineralized water but can also be developed. In the southern part of the township overburden aquifers are absent and bedrock aquifers must be utilized. Care is required in drilling as mineralized water is common and occurs close to fresh water zones.

(b) Surface Water

Lake Erie is a good surface water supply for the southern part of the township. The flow in the Welland River is minimal in the summer months and would not provide a reliable source of supply.

4. Future Requirements

The Wayne Park water works system requires general repairs and more adequate chlorination.

III WATER POLLUTION

1. Sewage Disposal

The Long Beach Park operated by the Niagara Peninsula Conservation Authority is served with an oxidation pond which operates satisfactorily.

In the remainder of the township, septic tank systems or privies are employed. There is a pollution problem during the summer months in the cottage area of Long Beach. Septic tank effluent has been noted in ditches at the communities of Chambers Corners and Wainfleet. In these small communities where municipal sewerage systems are probably not feasible, improvement of the private disposal systems is necessary.

2. Refuse Disposal

Two sites are used for the open disposal of refuse. Neither of these appear to cause water pollution.

3. Industrial Waste Disposal

The Forks Road Creamery at Winger employs spray irrigation to dispose of process waste water through most of the year. During winter months, waste water is discharged directly to an intermittent tributary of Forks Creek.

The M. Uzelman Slaughterhouse, the Murray Winger Slaughterhouse, the Maciejowski Cured Meats establishment employ adequate septic tank and tile bed systems. A poultry processing plant is being constructed at the Reeb Farms and a waste stabilization pond has been approved.

Waste water from the R. E. Law Crushed Stone Limited, gravel washing operation is returned to the quarry.

4. Surface Water Quality

The results of samples collected from the Welland River and its tributaries, are recorded in Table 17-1. Refer to map 17-1.

Only three of the 17 samples from Forks Creek and tributaries, were satisfactory with respect to both the BOD and coliform organisms. Although the Forks Road Creamery has been a major source of pollution, other contributing factors are improper domestic sewage disposal and pollution from agricultural sources.

Six of the 20 Welland River samples were satisfactory. Pollution from domestic and agricultural sources in this section of the Welland River is noted.

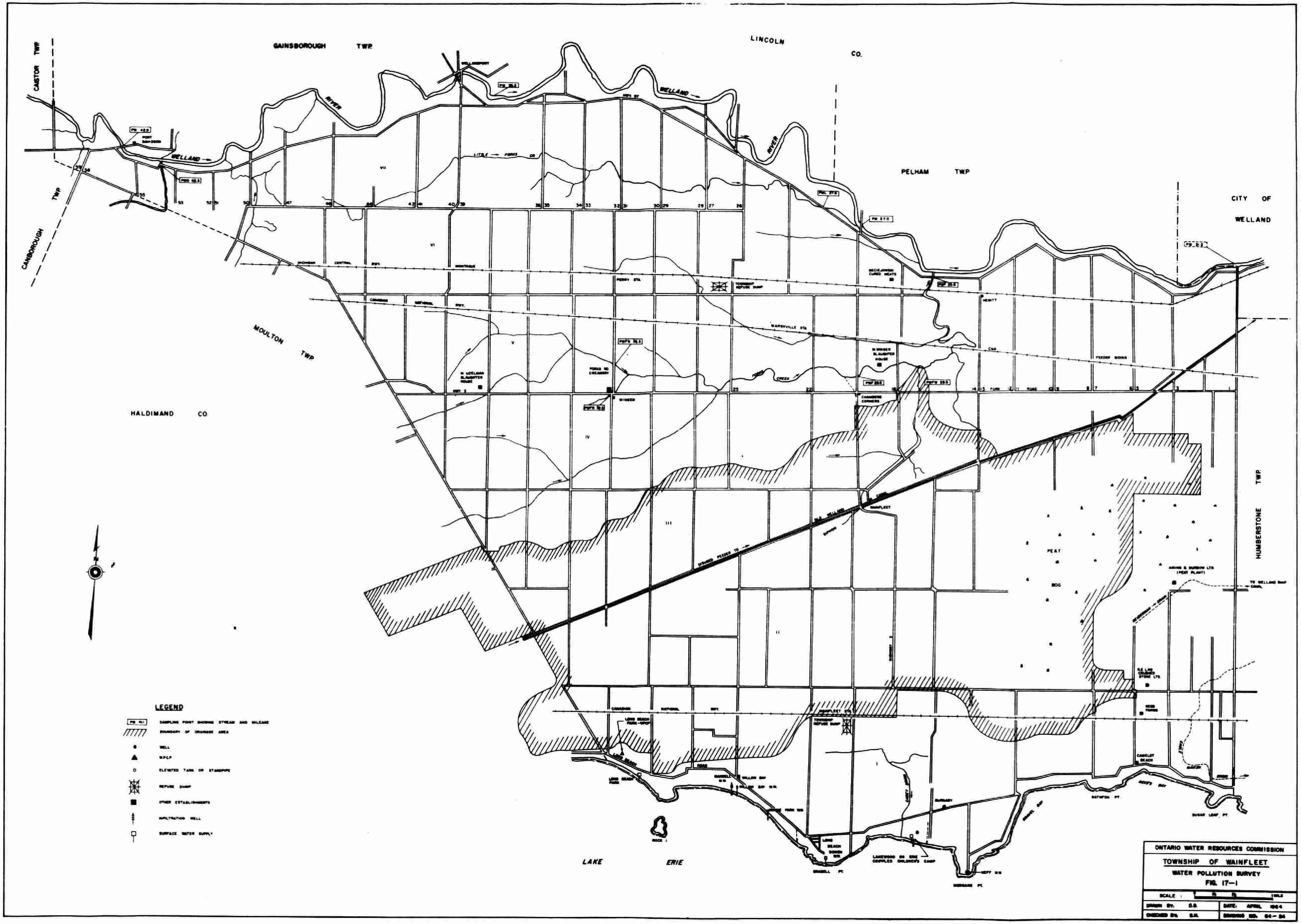
5. Future Requirements

In the cottage areas, particularly at Long Beach, the eventual solution to sewage disposal problems is the provision of municipal sewage works system.

IV CONCLUSIONS

Adequate chlorination practices should be maintained for the Wayne Park water works system.

Consideration should be given to the provision of municipal sewerage works for areas of high population density, where private disposal facilities have proven unsatisfactory.



ONTARIO WATER RESOURCES COMMISSION

TOWNSHIP OF WAINFLEET

WATER POLLUTION SURVEY

FIG. 17—1

SCALE : 0 ½ 1 MILE

DRAWN BY: D.B.
DATE: APRIL 1964
CHECKED BY: S.H.
DRAWING NO. 64-26

TABLE 17-1

SAMPLE RESULTS - TOWNSHIP OF WAINFLEET

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliforms per 100 ml
				Total	Susp.	Diss.		
PW 21.2	Welland River west opposite Pelham Township-Welland line	June/59	14	334	64		87	50,000
		Feb./61	5.6	264			2	7,700
		June/62	2.8	300			45	39,000
		May/63	4.4	396			65	37,000
		Sept./63	2.6	342	54			6,000
PWF 25.6	Forks Creek at Highway No. 3A	July/59	9.2	284	46			100
		Feb./61	5.3	396			3	39
		June/62	2.0	322			43	25,000
		May/63	3.2	340			53	360
PWFW 28.5	Wainfleet Branch Forks Creek at Concession Road 4 and 5 - Wainfleet Twp.	June/59	3.6	560	70			10,000
		Feb./61	14.0	798			10	5
		June/62	4.4	436			48	109,000
		May/63	3.4	460			59	5,000
PWF 28.9	Forks Creek at Highway No. 3A just north of Chambers Cor.	June/59	5.0	432	70			100
		Feb./61	30	566			34	110
		June/62	2.6	462			48	61,000
		May/63	2.8	490			50	150
		Sept./63	2.6	410	23			100

TABLE 17-1 (cont.)

SAMPLE RESULTS - TOWNSHIP OF WAINFLEET

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids (ppm)			Turbidity in Silica Units	M.F. Coliforms per 100 ml
				Total	Susp.	Diss.		
PWFR 32.3	Branch from Winger (just below) beside Highway No. 3	June/59	95	4326	72			<10,000,000
		Feb./61	1,000	4364	196			700
		June/62	3.6	348			9.0	66,000
		May/63	3.1	792			8.0	5,000
PW 27.0	Welland River just opposite junction of No.3A and No. 57 highways	June/59	3.2	286	38		58	71
		Feb./61	4.0	342			-	2,500
		June/62	1.8	328			45	10,000
		May/63	2.5	348			45	1,010
		Sept./63	3.0	346	20			900
PW 35.2	Welland River ½ mile below Wellandport beside Highway No. 57	June/59	5	356	26		42	600,000
		Feb./61	6.5	570			4	0
		June/62	2.6	360			43	5,000
		May/63	2.8	282			17	410
		Sept./63	1.8	380	21			180
PWO 42.3	Oswego Creek at road just above junction	June/59	10	372	48		70	100
		Feb./61	6.7	1424			8	20
		June/62	4.8	466			42	8,000
		May/63	4.1	342			18	380
		Sept./63	2.8	428	39			210

TABLE 17-1 (cont.)

SAMPLE RESULTS - TOWNSHIP OF WAINFLEET

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids (ppm) Total	Susp.	Diss.	Turbidity in Silica Units	M.F. Coliforms per 100 ml
PW 42.9	Welland River at Talbot Road just west of Pt. Davidson Station	June/59	5	342	32		65	36
		Feb./61	9.4	1332			6	20
		June/62	4.8	520			50	11,000
		May/63	5.0	414			53	1,000
		Sept./63	3.2	616	67			600
DISUSED FEEDER CANAL								
PWFC 23.1	Disused feeder canal at Highway No. 3	May/61	6.0	290	49	250	43	20
PWFC 31.4	Disused feeder canal at sideroad crossing south of Winger	May/61	3.6	244	26	218	19	52
LAKE ERIE								
WA 4 DS	Long Beach area storm sewer outlet	July/59	14	254	16	238		1,000,000
		May/61	4.4	316	56	260		10

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CHAPTER 18

TOWNSHIP OF WILLOUGHBY

I GENERAL

The township is located in the east central section of the county. The land surface drains to the Welland River and the Niagara River. Lyons Creek is tributary to the Welland River and Usshers, Bayers, Black and Baker creeks are tributaries of the Niagara River.

The assessed population of the township is 2,023 persons. The economy is predominantly agricultural. Development occurs adjacent to Niagara Falls and Chippawa and at Douglastown.

II WATER SUPPLIES

1. Municipal

Water from the Chippawa municipal system is supplied to 23 consumers on Lyons Creek Road and Sodom Road.

2. Private Water Supplies

Douglastown Water Works

Forty-five homes in the community are served by the Douglas Park Water Consumers Corp. Inc. water system. Water is drawn from an infiltration gallery on Black Creek. Treatment consists of sand and gravel filtration, activated carbon filtration and chlorination. The low lift pump has a capacity of 0.1 mgd and the high lift pumps have a total capacity of 0.86 mgd. The limiting filtration capacity is .034 mgd.

Coliforms have ranged as high as 8,000 coliforms per 100 ml in the raw water. Frequently adverse coliform counts have been determined in the treated water.

Tastes and odours have also been experienced.

The chemical water quality is shown by the following summary of analyses obtained from 1960 to 1963.

Characteristics	No. of	Raw Water			No. of	Treated Water		
	Samples	Avg.	Min.	Max.	Samples	Avg.	Min.	Max.
Hardness as $CaCO_3$	6	189	108	268	7	226	168	278
Alkalinity as $CaCO_3$	6	96	34	200	7	97	52	140
Iron as Fe	6	2.5	0.08	4.4	7	1.62	0.1	2.5
Chloride as Cl	6	33	14	99	7	42	16	66
pH at Lab	6	7.6	7.4	8.4	7	7.5	7.1	7.9
Colour in Hazen Units	6	155	10	280	7	98	15	150
Turbidity in Silica Units	6	46	8	81	7	35.6	3	68
Fluoride as F	3	0.47	0.2	1.0	2	0.6	0.2	1.0
Lead as Pb	2	0.3	--	0.3	1	0.0	--	--
Free Ammonia as N	3	0.51	0.16	1.05	3	0.26	Trace	0.66
Phenol in ppb	1	20	--	--	1	5	--	--

Black Creek constitutes a source of poor quality water. The raw water is highly coloured, turbid and has an excessive iron content. At times the lead and phenol concentrations have been notable. The free ammonia concentrations indicate an organically enriched water.

Treatment is inadequate. Analyses show excessive average turbidity, colour, and iron concentrations. High concentrations of phenol have also been noted in the treated water. The hardness, alkalinity, chloride and fluoride have fluctuated widely.

Residents along the Niagara Parkway generally obtain water from the Niagara River, either directly or by means of infiltration wells. In the remainder of the township, dug wells are preferred, as drilled wells usually yield highly mineralized water containing hydrogen sulphide.

3. Potential Additional Supplies

(a) Ground Water

Additional supplies of fresh water from ground-water sources are limited because overburden aquifers are sparce and the incidence of sulphurous water is high in bedrock aquifers. In areas where fresh water cannot be obtained from drilled wells or municipal water works systems, dug wells could be utilized for domestic supplies.

(b) Surface Water

The Niagara River on the east of the township is a suitable source of raw water for the development of future supplies. The Welland River on the north of the township contains Niagara River water, when the Chippawa-Queenston Power Canal is in service.

4. Future Requirements

Black Creek is a poor water supply source. An alternate supply for the Community of Douglastown from either the Niagara River or neaby municipal systems is advisable. In the meantime, extensive improvements at the water treatment plant are required including coagulation and settling facilities, improved filtration, a new intake directly to the creek and taste and odour control. Chlorine dioxide treatment has previously been suggested.

III WATER POLLUTION

1. Sewage Disposal

There are no municipal or community sewerage works in the township. Individual septic tank systems are generally employed.

A number of septic tank systems in the Douglastown area are defective of inadequate, and sewage material accumulates in local ditches. The following sample from a roadside ditch illustrates considerable pollution.

Date	5-Day BOD	Total	Solids Susp.	Diss.	M. F. Coliforms per 100 ml
Apr/62	100	766	158	608	870,000

The Willow-Dell Golf Club has proposed to construct a sewage stabilization pond.

2. Refuse Disposal

The open refuse dump does not contribute to pollution of Bayers Creek.

3. Industrial Waste Disposal

The Riverdale Frozen Foods Limited employs subsurface disposal systems which are effective.

4. Surface Water Quality

Stream sample results are listed in Table 18-1, and the sampling locations are shown on Figure 18-1.

At times, the Welland River exhibits excessive coliform densities which may in part be attributed to the effluent from the Niagara Falls-Stanley Road septic tank. Lyon's Creek receives industrial wastes and sanitary sewage from the City of Welland.

The presence of decaying organic matter is indicated in the Usshers Creek sample results. The creek does not receive any significant amount of pollution and conditions are unchanged since 1961.

The coliform densities in Bayers Creek are low.

The adverse quality of Black Creek can be related to pollution originating from Douglastown and from Stevensville.

The water quality in Baker Creek is generally satisfactory.

5. Future Requirements

The private sewage disposal systems serving the existing homes should be maintained.

If further residential construction is undertaken at Douglastown, a community sewage disposal system should be provided.

Generally the creeks are inadequate for disposal of sewage effluent.

IV CONCLUSIONS

If the Black Creek continues to be used as a source of water supply for Douglastown, improved treatment will be required. The Niagara River would constitute a preferred source of supply. Consideration could be given to obtaining water from existing municipal systems.

The private sewage disposal systems in Douglastown require improvement.

TABLE 18-1

SAMPLE RESULTS-TOWNSHIP OF WILLOUGHBY

WELLAND RIVER AND LYONS CREEK

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids		Turbidity in Silica Units	M.F. Coliform Count per 100 ml
				Total	Susp.		
PW 9.2	Welland R. west at Crowland Willoughby Line	June/59	2.8	190	4	16	300
		Feb /61	4.2	220		5	5,000
		June/62	2.2	196		1.7	14,100
		May /63	2.6	200		3.5	730
		Sept/63	1.2	188	2		3,800
PWE11.1	Welland R. (east) opposite Golf Course west of Stanley Road	June/59	0.9	186	6	8.1	130
		Feb /61	3.8	184		3.0	13,800
		June/62	1.6	240		3.8	24,300
		May /63	2.9	196		7.0	42,000
		Sept/63	2.2	198	11		41,000
PWE11.4	Welland R. east of Stanley Road	Feb /61	2.6	198		2.0	58
		June/62	0.6	220		1.3	3,800
		May /63	2.2	180		6.5	270
		Sept/63	1.6	186	2		1,300
PWE12.1	Welland R. (east) opposite Sodom Rd. west end of Chippawa	June/59	1.2	214	6	3	500
		Feb /61	1.5	154		3	3
		June/62	1.0	208		1.5	5,100
		May /63	2.4	144		5.0	290
		Sept/63	1.2	190	2		800

TABLE 18-1 - Cont'd.

SAMPLE RESULTS - TOWNSHIP OF WILLOUGHBY

WELLAND RIVER AND LYONS CREEK - Cont'd.

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids Total	Solids Susp.	Turbidity in Silica Units	M.F.Coliform Count per 100 ml
PWE 12.8	Welland R. (east) at bridge - Chippawa	June/59	1.5	198	44	7	1,000
		Feb /61	2.8	178		1	45
		June/62	1.1	194		1.3	600
		May /63	2.5	136		4.0	200
		Sept/63	1.2	188	2		3,800
PWEL 12.0	Lyons Creek just above junction, at bridge	June/59	2.1	204	4	22	150
		Feb /61	2.0	226		3	1
		June/62	1.1	222		1.8	3,000
		May /63	2.8	240		11.5	33,000
		Sept/63	1.0	186	2		1,600
PWEL 13.8	Lyons Creek at Concession Rd. 5, Willoughby Twp.	June/59	3.8	242	12	24	50
		Feb /61	6.0	408	54		20
		June/62	1.9	312		13	150
		May /63	2.8	364		27	790
		Sept/63	1.0	280	3		
PWEL 14.6	Lyons Creek at Concession Rd. 6, Willoughby Twp.	June/59	2.0	274	28	25	20
		Feb /61	16.0	428	58		50
		June/62	1.9	328		2.8	3,000
		May /63	2.3	364		24	230
		Sept/63	1.6	296	7		150

TABLE 18-1 - Cont'd

SAMPLE RESULTS - TOWNSHIP OF WILLOUGHBY

WELLAND RIVER AND LYONS CREEK - Cont'd.

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids Total	Solids Susp.	Turbidity in Silica Units	M.F.Coliform Count per 100 ml
PWELT 14.9	Tee Creek at Concession Rd. 6, Willoughby Twp.	June/59	3.7	288	18	21	100
		Feb /61	14.0	1178	122		30
		June/62	1.8	332		3.8	4,000
		May /63	2.2	226		26	1,170
		Sept/63	1.7	296	10		120

TABLE 18-1

USSHERS CREEK

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids			Turbidity in Silica Units	M.F. Coliform Count per 100 ml
				Total	Susp.	Diss.		
US 0.1	Usshers Cr. just above outlet to Niagara River	July/59	1.6	190				-
		May /61	1.8	226			4	30
US 1.2	Usshers Cr. at first side road crossing above mouth	July/59	3.2	262	44	218		-
		May /61	4.4	280	40	240		20
US 2.1	Usshers Cr. at second side road above mouth	July/59	4.0	330	64	266		-
		May /61	5.2	280	32	248		3.2

BAYERS CREEK

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids			Turbidity in Silica Units	M.F. Coliform Count per 100 ml
				Total	Susp.	Diss.		
BY 0.1	Bayers Cr. just above outlet to Niagara River	July/59	0.9	194			15	
		May /61	2.3	236			7	10
BY 0.6	Bayers Cr. - first side road above mouth	July/59	2.8	408			115	
		May /61	6.0	380	80	300		30

TABLE 18-1

BLACK CREEK

Sampling Point No.	Description	Date	5-Day BOD (ppm)		Solids		Turbidity in Silica Units	M.F. Coliform Count per 100 ml	Iron as Fe (ppm)	Colour in Hazen Units
				Total	Susp.	Diss.				
BLO.1	Black Cr. at river road near mouth at Niagara R.	July/59	8.6	228			24	10,000		
		Aug /60	2.0				7	360		
		May /61	9.0	474	92	382		1,730		
		May /63	3.6	542			84	7,000	2.7	250
BLX0.2	Black Cr. improved watercourse	May /61	1.7	402	64	338		2,010		
		May /63	4.5	334			29	10,600	1.8	145
BL 1.6	Black Cr. at Queen Elizabeth Highway	July/59	9.6	312	24	288		1,000,000		
		Aug /60	5.0				78	700		
		May /61	1.8	464	92	372		1,120		
		May /63	3.6	578			110	4,900	4.8	130
BL 1.7	Black Cr. Douglastown water works intake	Aug /60	5.0				70	400		
		July/61	6.0	650	122	528		1,410		
		Apr /63						8,000		

TABLE 18-1

BAKER CREEK

Sampling Point No.	Description	Date	5-Day BOD (ppm)	Solids			Turbidity in Silica Units	M.F. Coliform Count per 100 ml
				Total	Susp.	Diss.		
BK 0.1	Baker Cr. at	July/59	0.9	208			16	
	river road	May /61	5.6	228	40	188		370
BK 0.4	Baker Cr. 0.4	July/59	1.8	204			23	
	miles from mouth	May /61	3.0	204	24	180		20

APPENDIX

EXPLANATION & SIGNIFICANCE OF LABORATORY ANALYSES

All of the laboratory tests included in this report were performed at the Ontario Water Resources Commission Laboratory in Toronto.

A. BACTERIOLOGICAL EXAMINATION

Bacteriological examinations were performed on samples from water supplies, streams, and outfalls. The Membrane Filter Technique was used to obtain a direct enumeration of coliform organisms. These organisms are normal inhabitants of the intestines of man and other warm blooded animals. They are always present in large numbers in sewage and are generally minimal in other stream pollutants.

The results of the examinations are reported as "M.F. Coliform Count per 100 ml".

The Commission's objective for stream sanitation is a coliform density of not greater than 2,400 organisms per 100 ml.

B. STREAM AND OUTFALL SAMPLES

The chemical analyses performed on stream and outfall samples include determinations for biochemical oxygen demand, suspended solids, turbidity, and in some instances, pH, and alkyl benzene sulfonate (ABS).

BIOCHEMICAL OXYGEN DEMAND (BOD):

Biochemical Oxygen Demand is reported in ppm and is an indication of the amount of oxygen required for the stabilization of decomposable organic matter present in sewage, polluted waters, or industrial wastes. The completion of the laboratory test requires five days, under the controlled incubation temperature of 20°C.

The Commission objective for stream water quality is an upper limit of 4 ppm.

SOLIDS:

The laboratory carries out tests to determine the total and suspended solids in a sample. The value for dissolved solids is determined by taking the mathematical difference between the total and suspended solids.

The concentration of suspended solids expressed in parts per million (ppm) is generally the most significant of the solids analyses in regard to stream water quality. The effects of suspended solids in water are reflected in difficulties associated with water purification, deposition in streams, and injury to the habitat of fish.

Where suspended solids values approach 20 ppm or less, laboratory difficulties are experienced and, excepting the samples from sewage treatment works, the values of suspended matter are usually determined as turbidity.

TURBIDITY:

Turbidity is caused by the presence of suspended matter, such as clay, silt, finely divided organic matter, plankton and other microscopic organisms in water. It is an expression of the optical property of a sample and results are reported in "Silica Units".

pH:

The pH is an index of the acidity or alkalinity of the solution as represented by the instantaneous hydrogen ion concentration. The practical pH scale extends from 0, very acid, to 14, very alkaline, with the middle value of pH 7 corresponding to exact neutrality (at 25°C.). The objectives for surface-water quality as adopted by the OWRC suggest that the pH of the waters following initial dilution, should not be less than 6.7 nor greater than 8.5.

N/S

C. WATER SUPPLIES

The chemical analyses performed on water used as a source of supply for municipal or private systems include; hardness, alkalinity, chlorides, iron, fluoride, pH, turbidity, and colour.

HARDNESS:

No specific limit is usually placed on hardness although it is usually recommended that waters for domestic use should contain less than 250 ppm hardness as $CaCO_3$. This recommended limit has been used to avoid excessive soap consumption and other problems, primarily economic, usually associated with hard water. The degrees of hardness are indicated as:

Soft - 0-75 ppm as $CaCO_3$
Moderately Hard - 75-150 ppm as $CaCO_3$
Hard - 150-300 ppm as $CaCO_3$
Very Hard - greater than 300 ppm as $CaCO_3$

ALKALINITY:

Alkalinity of natural waters is due to the presence of salts of weak acids, usually bicarbonates. The concentration is reported in ppm as $CaCO_3$ and is significant in determining aggressive tendencies and softening treatment requirements.

CHLORIDES:

Chlorides are naturally present, in varying concentrations, in water supplies. Increasing chloride concentration may indicate contamination from domestic sewage.

The recommended maximum concentration to avoid saline tastes is 250 ppm.

IRON:

The recommended maximum limit for iron in water supplies is 0.3 ppm. It is noted that waters with concentrations of iron in excess of 0.3 ppm are not harmful to consumers but have objectionable staining and sediment-forming properties, and may cause the deposition of iron in pipes or the growth of iron bacteria. If the concentration exceeds 1 ppm, problems with metallic taste may occur.

FLUORIDE:

Fluoride may occur naturally in water or it may be artificially applied at the supply and/or treatment works.

A fluoride concentration of approximately 1 ppm is considered beneficial in the prevention of dental caries. The recommended maximum and minimum limits of fluoride are 1.2 ppm and 0.8 ppm respectively.

TURBIDITY:

The significance of turbidity is included in Section B.

The turbidity of treated water should not exceed 5 Silica Units.

COLOUR:

The colour intensity of water is reported in Hazen Units.

The colouration of natural water may result from contact with organic matter or chemical substances.

The recommended maximum colour content is 15 Hazen Units.

FREE AMMONIA:

Free ammonia represents the first product of decomposition of organic matter and thus appreciable concentrations of free ammonia usually indicate "fresh pollution" of sanitary significance.

Low - 0.015 to 0.03 ppm
Moderate - 0.03 to 0.10
High - 0.10 or higher

Omit

TOTAL DISSOLVED SOLIDS:

The effect of total dissolved solids influences taste and the laxative properties of a water supply. A limit of 500 ppm is used.

NITRATE:

Nitrate levels are specified as excessive concentrations may cause methemoglobinemia in infants. A limit of 45 ppm nitrate is specified as the upper limit.

DATE DUE

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